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THE ELECTRIC RAILWAY.

Commencing with the present issue of THE ELECTRICAL WORLD more attention than usual will be paid to that branch of applied electricity which has perhaps, if discernment be possible, made the most rapid strides in the development of electrical industries. Notwithstanding the enormous field which the electric railway has created for itself within comparatively few years, neither the past nor the present affords a sufficient basis upon which to estimate its future possibilities. It has always been the aim of THE ELECTRICAL WORLD to treat as thoroughly as possible all subjects of electrical interest, either of a theoretical or practical nature, without confining attention to the more definite branches into which electrical subjects naturally divide. It is for the purpose of more impartially treating the electric railway and its development that the present innovation is made, but not, however, with any idea of sacrificing those interests to which in the past we have been devoted, but on the contrary, by added efforts, to make our columns of increased interest to all devoted to electrical progress.

COMPRESSED AIR AGAIN.

Renewed efforts are periodically put forth to revive interest in some one of the favorite schemes of street-car propulsion, the latest being those of the compressed air advocates. The chief claim for recognition is now based upon the fact that they are able to utilize a pressure of 2000 pounds per square inch, instead of 500 pounds, as previously experimented with. It is safe to say that the difficulties involved by the employment of this excessive pressure when added to those which have hitherto proved insurmountable in commercial practice, afford sufficient grounds for believing that electric railway interests are not likely to soon be placed in jeopardy, nor that apprehension need be felt by this revival of an old claimant. Present prospects already point toward a legal war between the two rival companies now exploiting compressed air claims, which is likely to be instigated as soon as the first car is operated. The interest at first displayed by the traction company has materially subsided within the past few weeks, the majority of the directorate now favoring the conduit system and desiring to have it extended on other parts of the company's lines. It remains, however, to be seen what effect the actual working of the compressed air cars will have upon these present opinions, and inasmuch as the claims set forth in favor of compressed air still remain to be demonstrated, the outlook is promising for another epoch of undisputed sway for electric traction.

THE SEAT OF ELECTRODYNAMIC FORCE.

An interesting and valuable communication by Messrs. Houston and Kennelly will be found elsewhere in this issue "On the Seat of the Electrodynamic Force in Ironclad Armatures." The authors have experimentally demonstrated that in the type of armature employed by them more than 98 per cent. of the entire torque was exerted on the iron, less than 2 per cent. being produced by the conductors. This fact is directly contrary to the conditions which exist in the smooth-core type, and has generally been deprecated as a mode of explaining the action of motors in general. The experiments which the authors have made apparently demonstrate that the action of the induction motor having buried conductors is more correctly explained on the hypothesis of a rotary magnetic field, under the conditions, of course, when a resultant field produced by displaced currents exists, rather than due to the transformer action existing between stator and rotor. Even in those types where no resultant field

is produced, the primary action is to be considered as magnetic rather than electrodynamic. This view was formerly entertained as explaining the action of all direct-current motors, and, until thrown aside, remained one of the chief obstacles to their improvement. It is for this reason that we are somewhat loath to revert to it as the explanation for the action of the iron-clad armature. The subject is one which directly bears upon the discussion of the paper presented before the Institute in March, 1895, by Prof. Ryan and Mr. Thomson, and clearly elucidates a point which remained in doubt at that time.

HIGH-VOLTAGE LAMPS.

The advantages to be gained by the use of high-voltage lamps were thoroughly exploited at the recent meeting of the Municipal Electrical Association in England. The growing interest which is now being taken in this subject abroad has been gradually making itself felt in this country during the past two years. Although some 20 plants are now in operation they have not been installed on such an extensive scale as those on the other side, the largest having a maximum load of about 3000 lights. Radical differences exist however in the lamps employed, the type now used consisting of a single anchored coiled filament rather than a combination of two lamps or two filaments in one bulb. Such practice as the latter involves can scarcely be considered as meeting the difficulties to be overcome in the manufacture of high-voltage lamps. We are pleased to note that American manufacturers have succeeded in producing a single filament 3.5 to 4 watt 220-volt lamp, having a life comparing favorably with the low-voltage productions. Central station managers operating small plants now have the opportunity of doubling up their voltage, thereby greatly increasing the capacity of their mains and diminishing the percentage of fluctuation Outlying districts four times the distance from the station now supplied may be taken in and in fact all of the advantages possessed by the 220-volt three-wire system obtained without involving the use of the neutral wire and its attendant complications. A 3.5-watt 220-volt lamp having a life of 800 hours is to be considered a success and its field of application will rapidly widen.

THE HUMILITY OF A GREAT MAN.

With the full reports at hand of the Jubilee given in honor of Lord Kelvin we are compelled to add still another comment of admiration for England's greatest scientist. Seldom, indeed, is such honor bestowed upon an individual or received with more unaffected modesty and simplicity. He did not dwell upon the advances made in science and invention during his tenure of the Chair of Natural Philosophy at the University of Glasgow; neither did he think that he deserved credit for the work which he had accomplished. "One word," he said, "characterizes the most strenuous of the efforts for the advancement of science that I have made perseveringly during 55 years. That word is failure. I know no more of electric and magnetic force, or of the relation between ether, electricity, and ponderable matter, or of chemical affinity, than I knew and tried to teach to my students of natural philosophy 50 years ago in my first session as professor. Something of sadness must come of failure, but in the pursuit of science, inborn necessity to make the effort brings with it much of the *certaminis gaudia* and saves the naturalist from being wholly miserable, perhaps even allows him to be fairly happy in his daily work." Such was Lord Kelvin's estimate of the aid which he had rendered in the advancement of science. He confessed that the problems which he had set out to fathom still remained unsolved and that his ambitions had resulted in failure. He still believed, however, that the time will come when the dark side of physical science shall be made bright and clear, in another generation if not in the present. Few men could have passed through such a demonstration without the feeling of a personal triumph and self-conscious pride. We do not wonder that Lord Kelvin retains in the English heart such an affectionate esteem, and we are glad to pay tribute to one possessing such remarkable qualities.

OLD RAILS AS RETURN FEEDERS.

One of the cheapest ground returns that can be built may be constructed of old rails. Flat rails are the most convenient for the purpose and are usually the most available. They may be readily laid between the rails or in the devil strip. It is necessary, however, in order that the rail thus laid shall materially reduce the resistance of the return circuit that it be exceptionally well bonded, otherwise there will be little gained. One point may be noted as being extremely favorable in this class of bonding. The rail is not subject to continuous jar as in the case of rails doing at the same time mechanical service, still the joints are subject to the gradual motion of expansion and contraction. The bond must therefore be flexible or it will gradually work loose. If such a feeder were laid with its joints staggering those of an active rail and cross-bonded thereto, the failure of a bond on either rail would be provided for. By drawing a sketch of the two rails and the bonds, it will be seen that by staggering the rails each joint is bridged by a rail, the path having four bond joints. If the joints are opposite, the number of bond joints in this reserve bridge is increased to six. The use of old rails for this purpose is very advisable, being both economical and durable. The electric continuity of the bond may be preserved from corrosion by imbedding it in an asphaltic compound. It is indeed singular that this method is not more widely used on the bonds of active rails.

The New York Telephone Company.

The Metropolitan Telephone & Telegraph Company, New York, is sending out notices to its subscribers and others having business relations with the company, that its business has been turned over to and will hereafter be conducted by the New York Telephone Company. Contracts in force between the first-named company and its subscribers and others have been assumed by the New York Telephone Company, to which has also been assigned all accounts due the Metropolitan Telephone & Telegraph Company. The notice is dated June 29, 1896.

Concurrently with this notice another is sent out by the New York Telephone Company, signed by U. N. Bethell, general manager, informing subscribers of the change in the system of charging for long-distance messages by the American Telephone & Telegraph Company. The notice, as issued by the last-named company, is as follows: "On and after July 1 the charge for overtime, beyond the initial period of five minutes, will be made by the minute, at the rate of one-fifth of a single message for each additional minute. We shall discontinue the practice of notifying the subscriber at the end of each five minutes how much time has elapsed."

There will be no change from the present method of charging excess time to suburban points, including Monmouth County and Lakewood, N. J.

A Distinguished Röntgen-Ray Subject.

Li Hung Chang, the eminent Chinese statesman, who represented the Chinese Emperor at the coronation of the Czar of Russia, and who is now in Berlin, on his way home, on June 26 submitted to a Röntgen-ray examination at the Charlottenburg Polytechnic. It will be remembered that when the treaty between China and Japan was being arranged the assassination of Li Hung Chang was attempted. The bullet from the would-be assassin's pistol buried itself in Chang's left cheek, where it still remains, its exact location being revealed by this interesting examination.

On the Seat of the Electrodynamic Force in Ironclad Armatures.

BY EDWIN J. HOUSTON, PH. D., AND A. E. KENNELLY, SC. D.

In the smooth-core armature of a motor, say of the drum type, it is known that the electrodynamic force, which urges the armature around, is exerted upon the conductors wound thereon, and not upon the armature core. In such armatures the wires are apt to be turned or sheared around the core by the action of unduly powerful currents.

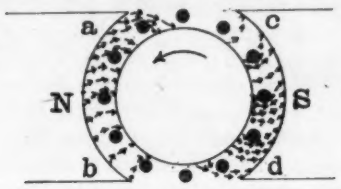


FIG. 1.—BIPOLAR SMOOTH-CORE DRUM ARMATURE.

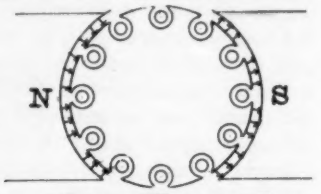


FIG. 2.—BIPOLAR TOOTHED-CORE DRUM ARMATURE. FIELD ACTIVE AND NO CURRENT IN ARMATURE.

Fig. 1 represents the cross-section of a drum armature with 12 wires laid over its surface, and with the flux paths diagrammatically indicated, when the field is excited and current is passing through the armature. If the wires were free to move, like a cage, around the core, they would exert the entire torque of the motor and if hysteresis were absent the core would have no tendency to rotate. The rotary effort of hysteresis in the iron core would necessarily be only a small fractional part of the entire torque of the motor, so that practically all the electrodynamic force exerted is upon the active conductors. When no current passes through these conductors, the magnetic flux is uniformly distributed through the air gap over the surface of the field poles and armature.

The effect of passing the working current through armature conductors is two-fold:

(1) It produces an M. M. F. across the main magnetic circuit, thereby crowding the magnetic flux at the pole corners *a* and *d*, and thinning it out at *b* and *c*, as shown.

(2) It produces a distortion of the flux around each conductor, and it is this distortion which is the origin of the electrodynamic force on the conductor.

In the toothed-core armature it is generally considered that the electrodynamic force is exerted almost entirely upon the iron core and not upon the conductors. In other words, the function of the working current passing through the armature is to magnetize the iron armature core, and the field magnet poles attract, so to speak, the magnetized core.

Fig. 2 represents a toothed-core armature situated in an excited bipolar field, but with no current passing through the armature. Here the distribution of magnetic flux is uniform, as shown. Fig. 3 represents an active toothed-core armature in the same field. Here the flux is crowded together at the leading polar edge, as before, and thinned out at the following polar edge.

It is usual to consider that the iron core is magnetized by the current so as to form, say, a north pole *n*, beneath, and a south pole *s*, above, and that if the distribution of magnetic flux from a cylindrical magnet of this power were superposed upon the magnetic flux produced by the field, the resulting magnetic forces

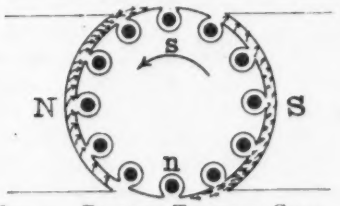


FIG. 3.—BIPOLAR TOOTHED-CORE DRUM, FIELD AND ARMATURE ACTIVE.

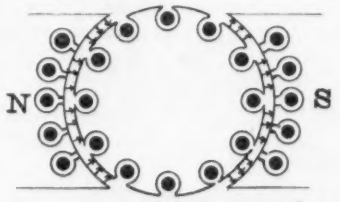


FIG. 4.—BIPOLAR TOOTHED-CORE ARMATURE WITH BALANCING FIELD TURNS. FIELD AND ARMATURE ACTIVE.

would have a torque identical with that of the electrodynamic forces indicated in Fig. 1. This view was, however, completely contradicted by the observations published in a paper by Prof. H. J. Ryan, on "A Method for Preventing Armature Reaction," read before the American Institute of Electrical Engineers in March, 1895 (Transactions, vol. xii., p. 84).

In carrying out his method of preventing armature reaction, Prof. Ryan applied an external M. M. F. on his toothed-core armature, equal and opposite to the internal M. M. F. developed in the armature conductors in the usual way. This was accomplished by cutting channels in the polar faces and embedding therein conductors, which carried the armature current. By exploring the distribution of magnetic flux entering the armature, Prof. Ryan showed, that when the balancing coils were left out of circuit, the distribution was dissymmetrical, as indicated in Fig. 3, but that when the balancing coils were introduced with their opposing M. M. F., the resulting distribution of magnetic flux over the surface of the armature could be made practically uniform. In other words, the iron core of the armature was no longer magnetized as represented in Fig. 3; for the ampere-turns of the balancing coils, wound in the pole faces, tended to produce a south pole where the ampere-turns on the armature tended to produce a north pole, and conversely. It was evident, assuming Prof. Ryan's observations to be correct, and they were too numerous to admit of experimental error in so fundamental a matter, that the armature core as a whole remained unmagnetized and yet the armature exerted its full torque. This is diagrammatically represented in Fig. 4, where the distribution of flux over the surface of poles and armature is indicated as uniform.

The question therefore naturally arises, does the driving force in the case of the toothed-core armature, with balancing turns, revert to the active conductors when the armature core as a whole ceases to be magnetized?

In order to answer this question, the authors have designed a small experimental motor in which the conductors are embedded in tunnels carried through near the surface of the drum armature core. A front view of this motor is represented in Fig. 5, where it is seen to be a small bipolar machine. Fig. 6 represents the armature removed

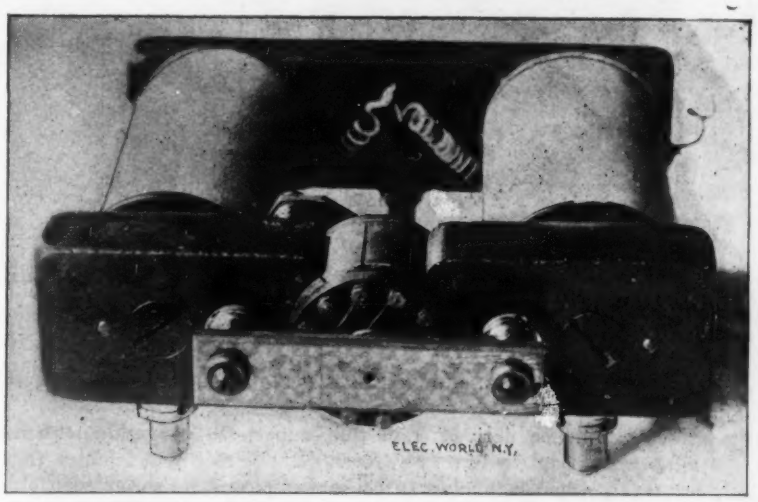


FIG. 5.—FRONT VIEW OF EXPERIMENTAL MOTOR.

from the field. The armature is a solid cylinder of soft iron bored with 12 quarter-inch holes. The armature core is supported in brass straps bridging the pole-pieces. The conductors, 12 in number, are mounted in a cage having hard rubber faces or ends, which are capable of revolving freely upon the core-shaft, through a small angular range; that is to say, within the limits of each core tunnel. There is no commutator, and the current was carried into and out of the conducting cage by flexible copper wires. Under these circumstances the armature core was free to revolve, and the armature conductors were also free to revolve independently of the core, but within narrow angular limits only. Two small pulleys were employed, one mounted on the core shaft and the other on the conductor cage, so that the torque exerted independently by each could be observed. The armature was never allowed to run and was only permitted to develop a torque through a very limited angular range of position.

The field magnets are of cast iron, and the pole-pieces are grooved with five parallel grooves for the reception of the balancing turns as shown in Fig. 7. The field winding consisted of 648 turns of No. 19 B. & S. wire on each field spool. With a current strength of one ampere passing through the coils in series, representing a total field M. M. F. of 1296 ampere-turns, or 1629 gilberts, the magnetic flux passing through the armature was, approximately, 50,000 webers, and through the centre of the cast iron yoke, about 64,250 webers. The maximum intensity in the iron teeth of the armature was, approximately, 13.1 kilogausses.

It was found that the frictional torque of the armature core with the field unexcited was, approximately, 10.6 gm-cms. The frictional torque increased when the field was excited to 42.4 gm-cms, representing a hysteretic torque in the iron core of 31.8 gm-cms.

When a current of 19 amperes, supplied by storage cells, was passed through the armature conductors, making five turns around the armature core, it was found that the magnetic torque on the iron core was 336.5 gr. cms, and on the conductors, only 5.4 gr. cms.

Taking the total magnetic pull upon the armature core as 378.9 gr. cms, the sum of the observed and frictional torques, the total magnetic torque on both core and conductors was 384.3 gr. cms, of which 98.6 per cent. was exerted on the iron and only 1.4 per cent. on the conductors.

It was also found that the insertion of five turns of balancing coil wound in the polar faces did not perceptibly alter the torques developed at the core pulley and conductor cage pulley, indicating that the pull is still practically all exerted on the iron, whether the balancing conductors are employed or not.

In the same way, a small angular motion of the iron core induces in the conductors a transient E. M. F., while the same range and character of angular motion in the conductor cage produced a barely appreciable E. M. F., and this whether the balancing coils were employed or not.

Fig. 6.—Armature of Experimental Motor.

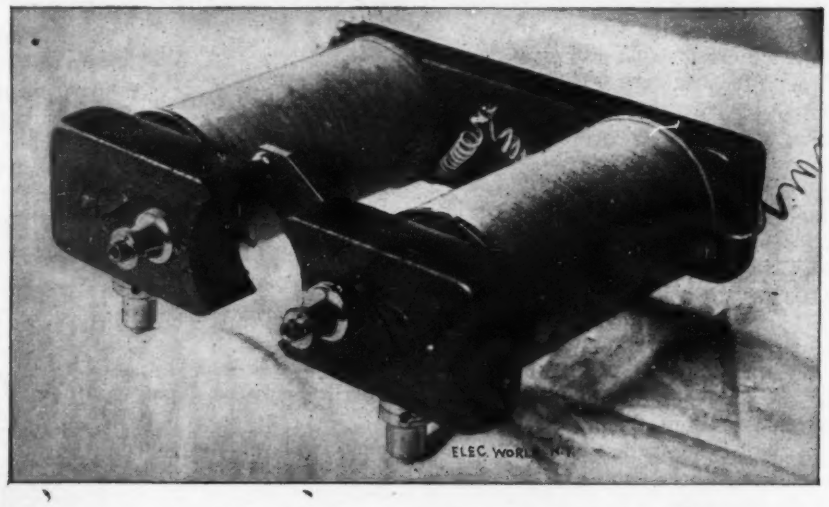


Fig. 7.—Field Magnet and Poles of Experimental Motor.

The evidence derived from this experiment, together with the experiments detailed in Prof. Ryan's above mentioned paper, indicate, that when balancing turns are employed, the iron core, as a whole, is not magnetized, but that the teeth are individually magnetized; that is to say, there is no dissymmetry of magnetic flux distribution over the surface of the armature core taken as a whole, but there is local dissymmetry of distribution on the surface of each tooth, whereby the flux is crowded at the leading edge and thinned out at the following edge of each tooth. By winding coils of insulated wire around the edges of the teeth, and connecting these coils with a ballistic galvanometer, we have observed that this action takes place. Consequently, the magnetic forces are locally exerted upon the teeth of the armature core.

If we accept this conclusion, it must follow that the distribution of magnetic flux in Fig. 4, although represented as uniform in so far that the same amount of flux enters each armature tooth as a whole, is not accurate in detail, since the flux passing into each tooth should be crowded at the advancing edge and thinned out at the following edge. Moreover, the same effects must be developed when no balancing turns are employed, as in Fig. 3, except that, in addition to the local dissymmetry at each tooth, there is an additional total dissymmetry over the surface of the entire armature.

The final conclusions appear therefore to be as follows:

First: The distribution of magnetic flux over the polar surface of a toothed-core armature may be regarded as practically uniform when no current passes through the armature.

Second: When the working current passes through the armature coils two effects are produced; viz.,

(*a*) A local dissymmetry of magnetic flux in each tooth whereby the flux is crowded at the advancing edge and thinned out at the following edge.

(*b*) The M. M. F. of the armature as a whole distorts the general distribution of the flux over its surface.

Third: When balancing coils are employed, the main distortion just alluded to under (*b*), may be annulled, but the local dissymmetry (*a*) is only slightly modified and remains in full force.

High-Voltage Lamps in Alternating-Current Practice.

In a paper read before the recent meeting of the Municipal Electrical Association (England), Mr. H. W. Couzens stated that cases, in his opinion, existed in which high-voltage lamps may be advisably employed. The standard practice for high-tension alternate-current work, he said, is to employ transformer sub-stations with a low-pressure distribution to consumers, but this hitherto had not been economically practicable in scattered residential districts, and distributed transformers were the usual means of supply. With a declared pressure of 200 volts at the consumers' terminals, however, the mains may be extended four times as far each way, and the saving in capital outlay on the transformers will probably balance the cost of the low-tension network; and the standby losses of a number of small transformers with relatively large magnetizing currents will be wiped out. In this way the 200-volt lamp should greatly aid in demonstrating the marked superiority of the alternating current for electricity supply, for by its help, in almost any class of district, the benefits of low-pressure distribution to consumers, combined with the advantages of high-tension transmission, are secured. Furthermore, this low-pressure network is small and isolated, and therefore exceedingly unlikely to give trouble from leakage.

The second case is where sub-stations are employed with distribution at 100 volts and not on the three-wire system, though such is rarely the case at present. Where it does occur, however, it is a comparatively simple matter to double the pressure at consumer's terminals, thereby diminishing the current density in the mains and making the same main take a much larger lamp connection.

Thirdly, where the distribution from the sub-stations is on the three-wire system at present, the 200-volt lamp is still of service and will prove to be of great value if the life of the patent is prolonged. Straggling consumers at some distance from the mains can be picked up; and there are many installations which it would not pay to connect at 100 volts, and yet would be profitable at the higher pressure.

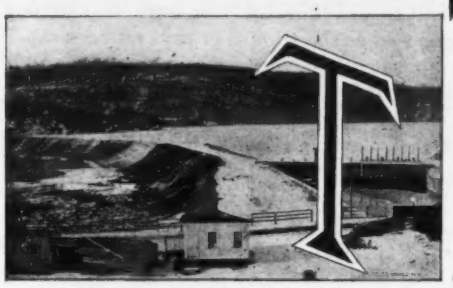
In all instances it should be borne in mind that if by any means the cost in capital outlay be reduced the consumer is bound eventually, though indirectly, to reap the benefit. He thought the engineers of alternating-current electricity works were too sceptical to take interest in high-voltage lamps at the present time. The best known makers of this class of lamp incidentally gave him to understand that their customers and the inquiries they received were at present almost exclusively from direct-current supply stations.

He considered that practical experience is the only proper basis of opinion on this question, and he had found his own altogether favorable. This was not due to any special care in arranging for the higher pressure, for the lamps were affixed and the pressure doubled without touching in any way the wires or fittings.

In conclusion he said that while to direct-current low-pressure supply the 200-volt lamp gives a new lease of life, not unattended with trouble in controlling 400 volts instead of 200, the alternating-current engineer can reap its advantages without any additional drawbacks of like character.

The Baltic-Taftville Transmission Plant.

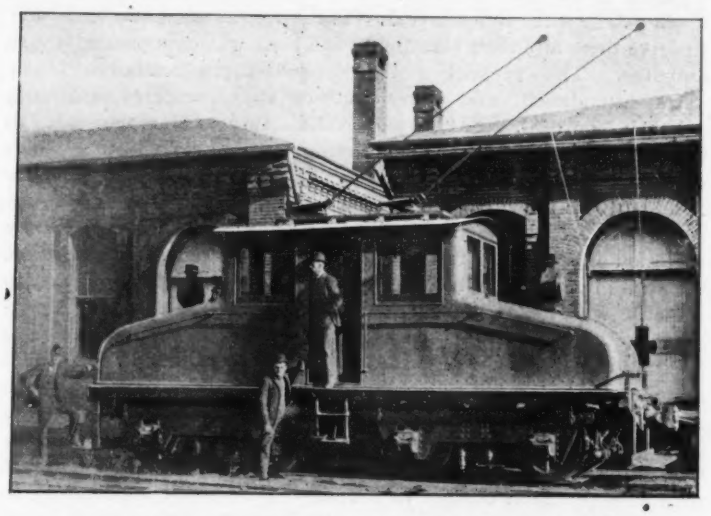
BY H. E. RAYMOND.



THE Ponemah Mills at Taftville, Conn., are operated by a cotton fabric manufacturing corporation noted for the high grade and fine quality of its production. The mills occupy two main buildings, the larger of which is 700 ft. long, and contains the departments of cording, spinning and all preparatory work and also a part for weaving. The machinery is driven by three Collins vertical shaft turbines, each of 500-hp capacity, and is provided besides with a steam auxiliary, consisting of two simple condensing 24 x 48-inch Greene engines, running at 104 revolutions per minute. The small mill, or the new mill as it is called, is situated 100 feet south of the former, is 500 feet long and contains the main weaving department with 1700 looms. The distance from the wheels in the old mill and the occasional scarcity of water precluded the use of the developed water-power, necessitating the use of other motive-power.

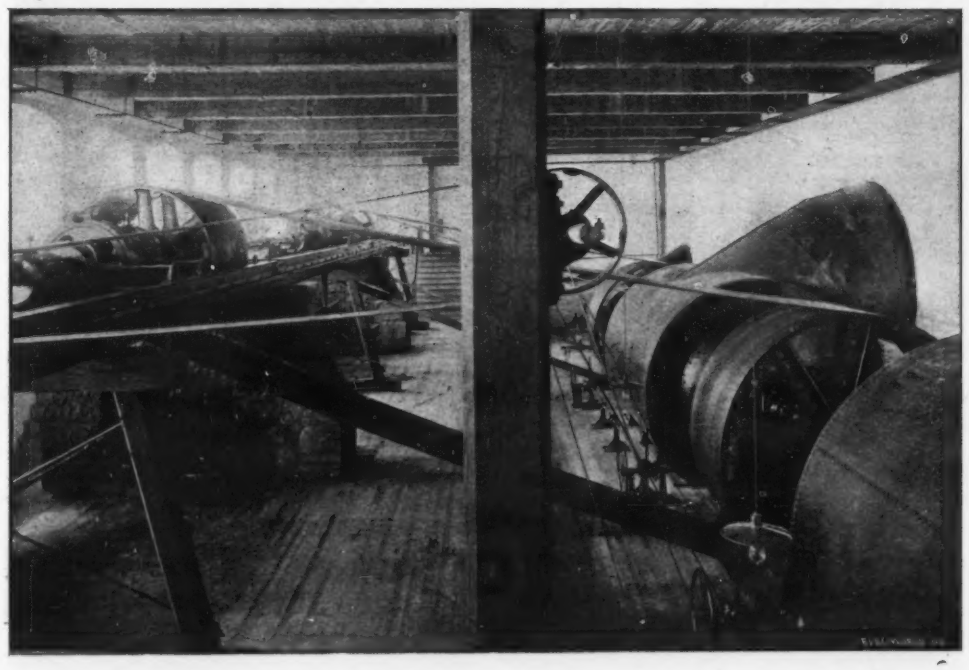
About 1892 the Norwich Street Railway Company changed its motive power for horses to electricity and a contract was made with the Ponemah Mill Company to furnish power to operate it. The road started in on a small scale and two T.-H. D 62, 500-volt generators were temporarily installed. The road soon increased, and another D 62 was added. A small flat tram car was run from the same generators. The increased railway demand soon proved too great a load for the original engines to carry, and it was decided to utilize the developed water-power privilege owned by the corporation four and one half miles up the Shetucket River and transmit this power by means of three-phase currents in sufficient quantity to replace the two engines in the new mill. The old dam was enlarged and now stands 34 feet high with a 500-foot span. The canal head and tail-races were widened and rebanked, and a considerable portion of the old mill was rebuilt by the Baltic Power Company in the north end of which the wheels and dynamos are installed.

The wheel room is clean, dry and well lighted, is 100 feet long by 33 feet wide and contains three pairs of Holmes horizontal turbines. Two of these are of 800-hp capacity and one of 300-hp. These are belted to quill pulleys, coupling to a seven-inch line shaft by means of Hunter clutches. The belts are 56 inches wide and 76 feet long on the 800-hp wheels and 36 inches wide on the 300-hp wheel. The belts were furnished by the Norwich Belting Company. The shafting is supported throughout the length of the wheel room on I-beam trusses and granite piers and runs at 310 revolutions per minute. The two largest quills run on roller bearings. The shaft extends through the wall into the dynamo room for 50 feet and is supported on brick piers. Coupled to this section of the shaft by clutches are two more quills, from which are belted two 250-kw 2500-volt, three-phase alternators. These alternators were installed in the Spring of 1894, and were wired so as to run either separately or in parallel. Being belted to the same shaft it is obvious that the slightest slip or inequality in belt or pulleys would make the slow generator a drag on the more rapid one if they were run synchronously, and owing to this fact it has been the plan to run each generator on individual lines, each carrying its own motor and lamp load. Some time after starting it was seen that the old style of switchboard apparatus would not fully answer the requirements, and a complete rearrangement of the equipment was made in switchboard and controlling devices.



ELECTRIC SWITCHING LOCOMOTIVE.

The dynamo room is also clean, dry and well lighted and ventilated. It is 106 feet long and 57 feet wide. It is sheathed overhead and on all pillars with galvanized iron painted white. Leaving this room at points convenient to the switchboard and to the lightning arresters, the line wires connect with the pole line at a point just outside the mill wall. From there they are carried on chestnut poles with triple-petticoat glass insulators to Taftville where the current is used.



WHEEL ROOM.

The transmission line consists of six wires and two cross-arms and in addition a concentric two-wire telephone cable carried on side brackets immediately below the cross-arms. These wires lead to the basement of the new mill at Taftville, passing from the lightning arresters to the motor switchboard. This switchboard is somewhat similar in arrangement to that at Baltic. Owing to the fact that the power station at Taftville was not designed for such use, it has been necessary to sacrifice appearance for safety, and in some cases, inconvenience. One generator supplies current for one motor which in turn drives the generating set for the Norwich Street Railway, and for two locomotives run by the mill company, one of 40 horse-power and the other of 500 horse-power and weighing 31 tons.

The railway generating plant consists of the three previously mentioned T.-H. machines and 1-MP 200-kw General Electric generator. The current is supplied on four feeders, at from 550 to 575 volts. This motor also drives a section on the main shafting, to which are belted the motors for 500 looms which utilize about 120 horse-power at the motor. The second generator at Baltic supplies one motor and 1200 24-cp lamps at Taftville. The motor drives the major portion of the main shafting and carries a load of 1200 looms. This

load requires an average current of 46 amperes at 2300 volts. The 1200 lamps are run at 114 volts, the voltage being reduced by two 40-kw sub-station transformers. The lamps are run on the regular three-wire system, giving very satisfactory service. The transformers are connected to the three primary lines, the secondary being in series with the neutral connection. With the neutral disconnected the voltage across the outside wires is 197 with 2280 volts primary pressure. When the neutral is connected between the lamps and to the common secondary connection the full ratio of transformation of twenty to one exists in each transformer. The present drop is less than 2 per cent. The old dynamos which operated on the two-wire system required constant attendance and a gallon of oil each per day. The commutators had to be turned down two or three times a year. The power at the motor necessary to drive them and their shafting at full load was represented by 24 amperes. The present method requires practically no oil or extra attendance, and takes but 12 to 14 amperes maximum primary current. At 2300 volts this difference of 10 to 12 amperes is a decided saving, especially as it enables us to run the second alternator below its rated load. The motors are identical with the generators in size, speed, output, etc., and run in synchronism with them. Having a separate field excitation, any variation of the field current of either motor or generator will affect the entire line voltage, advantage being taken of this condition to dispense with the pressure wires at the generating station. A constant pressure is maintained at Baltic, and slight variations due to fluctuations in load are regulated by the motor attendant. The ratio of generator to motor field-current for minimum line current is 20 to 1, and it is very indefinite at light loads. At or near full load the current curve under different ratios becomes more nearly a straight line, and a considerable change may be made in the field currents with no appreciable change in the line current, this opportunity to regulate the lamp main pressure at the consuming centre being embraced. While it has never been necessary to vary but a few volts either way, it may be of interest to state that a variation of 300 volts is obtainable with but three amperes increase in line current, and 350 volts variation with but four amperes. The increase being a wattless current requiring no extra power, 150 volts variation may be obtained with no apparent change in line current.

The motor which operates in multiple with the lamp primaries carries a constant load of looms. The lamp-load variations being regular and gradual, the necessary pressure regulation is due to the changes in speed caused by the fluctuations in the street railway load. These fluctuations in turn affect the Baltic generator and the water-wheels. The speed variation of the latter affects the second motor through the other two belts and the synchronous transmission to Taftville. As the voltage varies approximately as the cube of the speed and as the normal maximum variations are about 10 per cent. with no regulation, it speaks pretty well for the water wheel governor, which will be mentioned later. The lines on which the main mill load and lights are carried consists of No. 1 B. & S. waterproof copper insulated wire. The drop in voltage with 60 amperes per leg is 200. With an over-excitation of the motor field this drop may be decreased to 50 volts, the line current being increased four amperes. The average variation of the lamp voltage is 3 per cent. After some experimenting it was decided that the best service, life and illumination at moderate expense and considerable economy was obtained by the use of 24-cp 3.1 and 3.5-watt, 114-volt lamps. Attempts were made to ascertain the best size and shape of lamp bulbs, but the results varied so in each case that it is yet an open question. The general trend of opinion seems to be in favor of comparatively large bulbs with small necks and well rounded on the ends. This shape in a 24-cp lamp gives a light which although intense at the lamp is sufficiently diffused at the works to give uniform illumination, and the streaks of light radiating from the tip of the lamp which are reflected on the cloth are to a certain extent diminished. In the cloth inspecting rooms it was found difficult to examine the fine work turned out when clear glass bulbs were used as the streaks or rays prevent rapid inspection. The use of higher candle-power ground glass bulbs with fluted opaque shades overcame this difficulty, making a light almost equal to the daylight. On one floor of the mill lamps were suspended over the middle of the alleys and in line with the centre of two looms which faced each other.

The second method in order to avoid the use of long cords and drop lights with the necessary mains was to support the lamp on a curved pipe bracket from the floor. The former method proves the better.

To light the entire Ponemah Mill requires 3000 lights, in round numbers. Of this amount from 50 to 75 are burning constantly, 300 half the time, 1000 on dark days, and the total number only on dark days in the morning and evening during the Winter months. The power plant runs throughout the entire year and from 18 to 24 hours per day. By using a set of large units for the total load and a set of two 150-light transformers for continual service, lights may be used anywhere and at all times in the mill. This convenience is available without the use of a drop of oil or extra attendance. The direct-current system would require either a transmission of 1000 feet at 230 volts or two power stations and a set of three or four generators, so as to run three-wired at all times. A storage-battery auxiliary would obviate the necessity for continual running, but the distance of transmission would remain the same. This mill was lighted for years by gas, and the great improvement in the illumination, to say nothing of the avoidance of smoke, heat and vitiated air, has made the management enthusiastic admirers of the electric light.

The decrease in the output of second quality goods during the dark season alone makes a considerable item saved.

The motor driving the railway set and the 500 looms carries a load varying from 20 per cent. to 180 per cent. full load, sometimes receiving instantaneous fluctuations of 125 per cent. of the rated load. The lines conveying current to this motor are three No. 0000 cables furnishing a carrying capacity considerably in excess of present demands. A very slight drop in load, however, makes the extra amount of copper of great assistance to the motor when carrying a heavy overload, and it is practically impossible to force it out of phase with its generators, if the voltage is held at its brushes.

Arrangement of Lights in Ponemah Mills.

The Norwich Street Railway Company has 13 miles of track and

six severe grades and a number of smaller ones. The schedule necessitates the starting of all the cars every 15 minutes and within a few seconds of each other and all reach the heavy grades about simultaneously. It is apparent that the load variations above and below the average output are extreme, the fluctuations being from zero to 400 amperes in Summer and from 50 to 500 in Winter, the increased amount being due to heaters and slippage on the rails. On gala days the load varies from zero to 650 amperes, often 500 at a jump, and if the circuit-breaker opens at 650 the entire amount is cut off. By the use of the Lombard water-wheel governor, which is a model of mechanical skill, ingenuity and simplicity, the speed of the railway generators driven by power from the water-wheels four and one half miles away, and transmitted through five belts, varies but 4 or 5 per cent. in maximum. This governor consists primarily of a power pump, a reservoir for oil under pressure, a vacuum chamber, a cylinder with a piston actuated by the admission of oil at either end, a two-way admission valve and four governors moving the valve stem. The piston is provided with a rack on its rod which engages with a train of gears which in turn move the gate mechanism. The neatest piece of work on the governor is a device which so regulates the relative position of the valve stem with respect to the governor balls that even a continual change of load does not cause racing due to the inertia of the water. The regulation is so sensitive and rapid in its action and can be so perfectly adjusted that two wheels belted to the same shaft will run with the same amount of gate motion in each under the most trying load fluctuations and will govern so reliably that the water-wheels and a Corliss condensing engine coupled together by a synchronous motor system, four and one half miles apart, will carry the street railway load, each doing its proportion of the work.

The plant was one of the first three-phase power transmissions installed, and probably the first to combine mill and railway service.

A number of minor difficulties were encountered at first, due principally to the inadaptability of early auxiliary and controlling apparatus. Many experiments were conducted and a great deal of information gathered which have been of much use in designing the present equipment. Much credit is due to the General Electric Company for its willingness in working out designs from ideas gained in watching the difficulties developed, and its good will in furnishing perfected devices to replace those less adapted to the requirements.

The treasurer of both the Baltic Power Company and Ponemah Mills is Mr. Edward P. Taft and to his progressive and liberal spirit is due the fact that the plant was a pioneer in its field. The superintendent of the Ponemah Mills, Mr. John Eccles, is a scientific economist and much of the economy of operation is due to his ability as such.

The Kelvin Jubilee.

The celebration of the 50th anniversary of Lord Kelvin's assumption of the Chair of Natural Philosophy in the University of Glasgow took place on Monday and Tuesday, the 15th and 16th inst., amid considerable enthusiasm and in the best of weather, the Corporation and the university vying with each other to do honor to the greatest of living physicists. The first public event laid down in the programme was a conversazione in the University buildings, which took place on Monday evening. For two hours the invitees filed slowly into the Bute Hall which, although 2500 persons were present, was at no time inconveniently crowded. The guests were received at the entrance of the hall by the members of the University Senate and by the Lord Provost and magistrates of the Corporation of Glasgow, while seated on a dais, just inside the hall, Lord and Lady Kelvin received the greetings of those personally known to them. At about 9.30 p. m. Lord Kelvin proceeded, in company with the Italian Ambassador and other leading foreign scientific representatives, to the library of the university, where a fine array of Kelvin instruments was to be found, and where the officials of the Anglo-American Telegraph Company, the Commercial Cable Company and the Eastern Telegraph Company were busily occupied in sending and receiving congratulatory messages from all parts of the world. Of the many telegraphic feats performed, I need only mention that of the Anglo-American Company, which despatched a message of some 25 words from the Jubilee Committee on one side of the table to Lord Kelvin, who was on the other side, over a circuit of nearly 20,000 miles in length. This message went from one side of the table to the other *via* Hearts Content, New York, Chicago, San Francisco, Los Angeles, New Orleans, Jacksonville, New York and Hearts Content, the time occupied in sending the original message being 7½ minutes, Lord Kelvin's reply taking four minutes. The scene during the evening in the picturesque Bute Hall and in the Quadrangle was one not likely to be forgotten by those present, the "squeerl" of the bagpipes and the profusion of academic costumes giving the gathering a color and a variety not often seen.

On Tuesday the presentation of addresses by delegates from English and foreign universities, scientific societies, etc., took place in the Bute Hall. The doors were opened at 9.30 and at 10 o'clock precisely the delegates filed in. A few minutes afterward the Senate of the University, headed by Lord Kelvin, entered amid vociferous cheering. Then began the great function of this unique jubilee celebration. First of all a letter of congratulation was read from the Prince of Wales, and then for considerably more than an hour the delegates advanced in succession and presented their congratulatory and complimentary messages. Below is a list of such of the delegates as are best known to electrical readers:

M. Lippmann, University of France; M. Henri Moissan, University of France; M. Picard, University of France; M. Mascart, College de France, who presented the Arago Medal of the Académie des Sciences to Lord Kelvin; M. Violle, Ecole Normale Supérieure; Prof. Heinrich du Bois, University of Berlin; Prof. Quincke, University of Heidelberg; Prof. Woldemar Voigt, Royal Society of Science, Göttingen; Mr. T. C. Martin, National Electric Light Association, U.S.A.; Sir George G. Stokes and Prof. J. J. Thomson, Cambridge; Prof. Carey Foster and Sir Henry E. Roscoe, London; Prof. Oliver J. Lodge, Victoria University; Prof. Burdon Sanderson, Oxford; Prof. Andrew Gray and Principal J. Viriamu Jones, University of Wales; Prof. Stroud, Yorkshire College ; Prof. W. G. Adams, King's College; Prof. Ramsay, University College; Prof. Osborne Reynolds, Owens College; Sir Frederick Abel, Society of Arts, Mr. A. A. Common, Royal Astronomical Society; Prof. A. W. Rücker, British Association; Prof. John M. Thomson, Chemical Society; Sir Benjamin Baker, Institution of Civil Engineers; Dr. John Hopkinson, Institution of Electrical Engineers; Major P. A. MacMahon, Mathematical Society; Captain W. de W. Abney, Physical Society; Sir Joseph Lister, Royal Society; Prof. Schuster, Manchester Literary and Philosophical Society; Prof. Silvanus Thompson, Finsbury Technical College, and Mr. H. A. C. Saunders, Eastern, Brazilian Submarine, and allied cable cempanies. Among those who were present, and aisisted in the Jubilee proceedings, we may mention Prof. Cleveland Abbe, Weather Bureau, Washington; Prof. Roberts-Austen, Prof. Ayrton, Prof. G. H. Darwin, Prof. James Dewar, Prof. J. A. Ewing, Lord Rayleigh, Prof. G. F. Fitzgerald, Dr. Gladstone, Prof. Alex. B. W. Kennedy, Prof. Perry, Mr. W. H. Preece, and Prof. W. A. Tilden.

Lord Kelvin was then presented for the Degree of Doctor of Laws for the University of Glasgow and taking the chair proceeded to confer honorary degrees on a number of foreign delegates, and among others on Prof. Cleveland Abbe and Prof. Simon Newcomb. The long and imposing ceremony was then concluded by an address from Lord Kelvin, listened to with breathless attention by the audience.

On Tuesday evening the Jubilee festivities terminated with a banquet in the St. Andrew's Hall at which some 600 people were present. Before commencing the toast list the Lord Provost read a telegram from the Queen. The speeches, it must be confessed, were extremely dissappointing and quite unworthy of the occasion. Several speeches were absolutely inaudible to all but the reporters. When the Lord Provost proposed the toast of Lord Kelvin the whole audience rose to their feet, cheering, waving their handkerchiefs and clapping their hands and otherwise demonstrating their enthusiasm, a demonstration which was repeated when Lord Kelvin brought his reply to a close.

Perhaps the most characteristic feature of this memorable celebration was the genuine and hearty affection which was shown for the attractive personality of Lord Kelvin, and the zest with which the entire City of Glasgow threw itself into the work of doing honor to a Professor of Natural Philosophy.

Magnetic Separation of Oxygen.

According to Prof. Dewar, liquid oxygen may be drawn out of solid air by means of a magnet, the solid air having the consistency of a jelly.

Meters.*

Mr. Jas. Milne, in a paper on meters, discussed the various types of meters, paying particular attention to the Edison electrolytic, giving the history of its development and the various difficulties met with in making it a commercial success. The Ferranti, Shallenberger, Perry, Aron, Duncan, Thomson were among those included. In summing up the author stated that the advantages of the Edison chemical meter are: First: Practically no loss. Second: No moving parts. Third: Absolutely correct at all loads. Fourth: Will record the smallest possible amount of current. Fifth: It is applicable to any pressure. Sixth: Low first cost. Seventh: Low cost of maintenance. Eighth: Readily repaired. The only disadvantage (if any) is that the consumer can't read it for himself.

Motor Meters.—The only advantage is that the consumer can read the meter.

The disadvantages are: First, loss in overcoming friction in the moving parts; Second, incorrect at light loads; third, incorrect at quickly varying loads; fourth, first cost high; fifth, cost of maintenance high; sixth, not readily repaired.

Clock Meters.—In the Aron type of meter we have the following advantages: First, correct at all loads; second, will record the smallest possible current; third, as a coulomb meter it is applicable to any pressure; fourth, practically no loss; fifth, can be read by the customer.

The objections to this meter are, first, liability to stop recording if clock stops; second, first cost high.

We therefore see as a practical meter the chemical meter is superior in every point, save one, and that is the customer can't read it for himself.

The Edison meter has been condemned by a certain class, either through ignorance of its principle or prejudice, and our Canadian Government have also seen fit to practically condemn it—probably not condemn it, but to curtail the growth of a meter that has no superior and very few equals.

Mr. John Yule.

Mr. John Yule, the new president of the Canadian Electrical Association, is manager of the Guelph Light & Power Company, Guelph, Ont.

Previous to coming to Canada Mr. Yule was engaged in the gas business in Scotland, being for 10 years with the Dundee Gas

John Yule.

Company, and two years with the Dundee Municipal Gas Works. He has been associated with the gas interests of Guelph for the long term of 25 years, first as work superintendent and for the past 15 years as manager of the company.

When electric lighting was introduced into Canada the Guelph Company was one of the first concerns to enter into the business, and under Mr. Yule's management is to-day one of the most enterprising electrical companies among those located in the smaller cities in Canada.

Mr. Yule during his long term of office has been treated with the utmost confidence by his employers and is held in high esteem by the citizens generally.

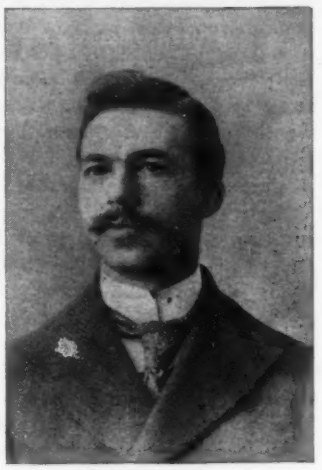
From the inception of the Canadian Electrical Association he has been one of its most active and intelligent workers and the success it has reached to-day is due, in no small measure, to his energy and intelligent thought. His election to the office of president by acclamation as fourth president of the association, and the first to be elected outside of the City of Toronto, is evidence of how highly he is esteemed by his associates in the association. There is every reason to believe that under his executive management the association will continue to grow and prosper.

* Abstract of paper presented before the Toronto meeting of the Canadian Electrical Association.

Mr. Lewis B. McFarlane.

Mr. Lewis B. McFarlane, vice-president of the Canadian Electrical Association, entered the service of the Montreal Telegraph

Lewis B. McFarlane.



E. Carl Breithaupt.

Company in 1865 and filled various positions from messenger up to manager. He was afterward employed by the Western Union Telegraph Company in the Western and Southern States. In 1876 Mr. McFarlane accepted a position with the Dominion Telegraph Company as manager at Toronto, Canada, and later succeeded to the position of assistant to the managing director. On the advent of the telephone Mr. McFarlane was appointed superintendent of the Dominion Telegraph Company's telephone department. He organized and put into operation telephone exchanges in all of the principal cities, towns and villages in the Dominion of Canada. In 1880, when the Bell Telephone Company of Canada was incorporated and took over from the telegraph companies and others interested all the telephone business then existing in Canada, Mr. McFarlane was appointed manager of the Eastern department of that company and has held that position for the past 16 years. Mr. McFarlane was promoted during the past month to the new office of general superintendent of the entire Canadian telephone system, his territory embracing the Provinces of Quebec, Ontario, Manitoba and the Northwest Territories.

Mr. E. Carl Breithaupt.

Mr. E. Carl Breithaupt, of Berlin, Ont., who has just been elected second vice-president of the Canadian Electrical Association, is one of the best-known electrical engineers in Western Ontario. He is recognized as a very thorough student of electrical science, entering into any question with the utmost diligence and enthusiasm.

Mr. Breithaupt was graduated from North Western College, Illinois, in 1887. Later he studied for several years at the Johns Hopkins University in Baltimore at post-graduate work in electrical engineering. Since then he has done consulting electrical engineering work in Canada.

At the present time Mr. Breithaupt is secretary and manager of the Berlin Gas Company, doing a general gas lighting business in the town of Berlin, and an electric lighting in the towns of Berlin and Waterloo. He is also president and general manager of the Berlin & Waterloo Street Railway Company, a short line of electric railway connecting the two towns, and is identified with several other electric railway projects in the immediate vicinity.

In 1893 Mr. Breithaupt was elected an associate in the American Institute of Electrical Engineers, and elected to full membership this year.

Mr. Breithaupt has been an active member of the Canadian Electric Association for a number of years, doing good work in different directions, and especially as chairman of the important Committee on Statistics.

Experiments with the Polarizing Photo-Chronograph, to Determine the Motion of Projectiles Inside the Bore of a Gun.

BY ALBERT C. CREHORE AND GEORGE O. SQUIER.

(*Continued from page 769, last volume.*)

A view of the rod prepared for use is shown in Fig. 3 (see last issue). The shrapnel was bored out from the front to the base part with an inch drill to compensate for the additional mass of the rod, and a wooden plug driven in to give a firm bearing surface for the base of the ballistic rod. A collar was turned upon the nose of the shrapnel to receive the ballistic rod which was firmly screwed in position. The wire embedded in the rod was securely fastened to the projectile. At first this contact was secured by simply screwing down the rod, thus pressing the wire upon the shoulder. Later, when the supply of unloaded shrapnel was exhausted, and it became necessary to use common shell, this method of securing contact was no longer reliable, as there were no screw threads in the projectile. It was more labor to prepare one of these common shells, as the front portion had to be cut off to make a bearing shoulder, and a hole bored through to the centre cavity to admit the wire. Advantage was taken of the base percussion fuse to ensure good electrical connection. The fulminate and plunger were removed and the cavity filled with mercury, into which the wire passed through the perforation in the vent, originally intended to admit the flame to the cavity. This arrangement of mercury cup contact, thus found already made, was as good as though especially designed for the purpose. After each rod and projectile were prepared they were carefully tested for good electrical contacts, since experience proved that contacts supposed to be perfect were sometimes defective, and neglect of this precaution would have lost much time.

SPACING OF THE COPPER STRIPS.

By any "dynamical method" the observations give points along a space-time curve. Since the number of these points is necessarily limited, their value greatly depends upon their position along the curve. The ideal positions of these points would seem to be at regular intervals along the arc of the curve itself. The form of the space-time curve is known to be such that observations at equal time intervals more nearly conform to the ideal than at equal space intervals. This also has the practical advantage of using the chronograph itself under the most favorable conditions. The copper bands should therefore be of varying lengths, the shortest being at the point of the rod. Accordingly, for a first trial, these lengths were approximated to in a rough way by simply taking the space-time curve to be a parabola, and the nearness of the approximation may be seen by the location of the observed points on the space-time diagrams given with each shot. Each negative was examined before the intervals on the rod for the succeeding shot were determined. Naturally the first attempts had only a few long intervals and these were made shorter and shorter in succeeding shots to determine how near together the records might be easily obtained. Beside this, another idea kept in view in designing rods was to cause the observations of succeeding shots to fall intermediately between those of previous shots, so that the number of points would be greatly increased along a resultant curve reduced from all the shots. The intervals along the prepared rods were carefully measured with a steel millimetre tape, estimating to tenths of a millimetre.

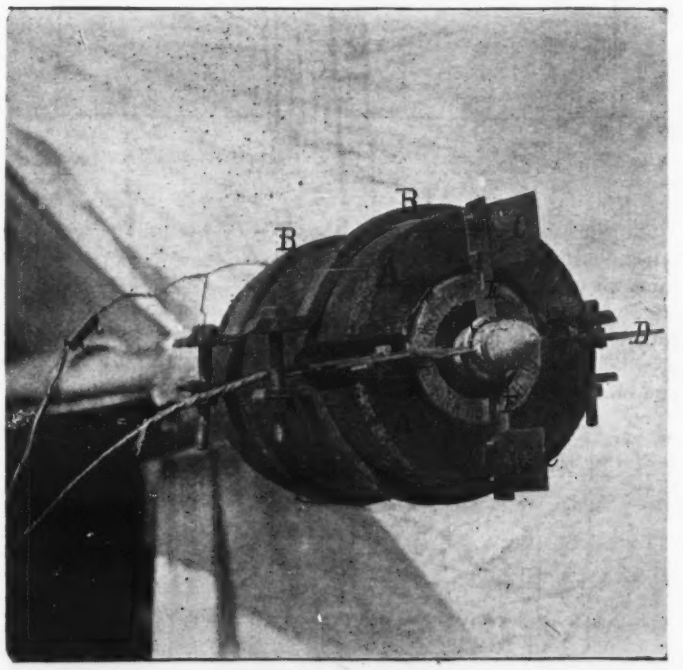


FIG. 4.

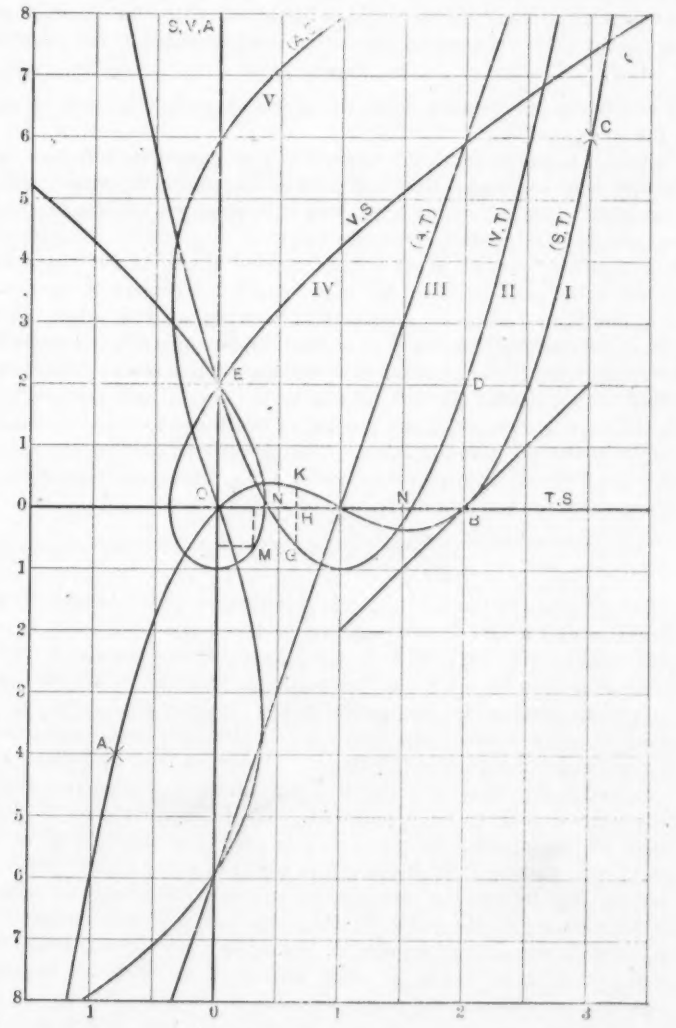


FIG. 5.

The "spider ring brush."—A single ring brush being possible, a new device for supporting it at the muzzle was constructed. A view of this device is shown in Fig. 4. *A A* is the wooden collar turned to fit the front of the chase, and prevented from displacement forward during discharge by the swell of the muzzle of the gun. *B B* are circular iron straps capable of adjustment, for securely holding the collar in position. The wooden collar was slit into four equal sectors and the hard steel pieces *C C*, *D D* extending the length of the collar were securely screwed, one to each sector, to facilitate taking apart and assembling the support. The entire collar and steel strips were insulated from the gun by the insulating wood of the collar itself, and by wrapping tough paper upon the gun and assembling the collar over it. *E E*, *F F* are four other iron strips bolted to the former pieces as shown, and capable of adjustment along radii by means of slots for the securing bolts. These radial pieces served as immediate supports for the ring brush, which was grasped by four half circular holes in the inner edges of the radial strips. The form of the brush first used was an iron ring slightly larger than the rod, but experience finally led to the "spider ring brush" shown in the

figure. This is made of ¼-inch brass rod bent into a circle of 1¾ inches internal diameter. Into this ring were driven spring brass wires $\frac{1}{20}$-inch in diameter projecting ½-inch in front of the ring and inclined at an angle inward so as to press against the rod. These spring wires were added to ensure a continuous connection with the rod, and cause the breaks in passing from copper to wood to be uniform and definite for each of the strips, since some of the spring wires are in contact at all times. One of the greatest advantages of this ring brush with its four radial supports is that it offers a very small surface to the action of the blast. A front view of the muzzle device with simple ring brush is shown in Fig 8.

REMARKS ON OBSERVATIONS.

It is an advantage to have observations given in a graphical as well as tabular form, and accordingly they are presented by points indicated by crosses through which broken dotted lines are drawn. The importance of the graphical method of viewing problems of this character, exhibiting to the eye the fundamental relations which connect the different equations together, and making it possible to pass from one curve, which is the geometrical equivalent of an equation, to another in cases where the equations may be either unknown or very complicated so that the equivalent process of algebraic elimination is impracticable, it seems, has not been sufficiently emphasized, and it is for this reason that it is thought the elementary character of the following explanations will be acceptable:

Without any special reference to ballistics, let us consider the abstract problem of the motion of a point along any line in space. Referring to Fig. 5, let the position of this moving point at any time be represented by the curve ABC. Time t is measured along the horizontal, and the distance s from the origin along the vertical axis. Thus a point C upon the curve means that the moving point had moved six metres from the origin in three seconds. As an example suppose it to be known that the motion is represented by the equation

$$s = t^3 - 3t^2 + 2t, \qquad (1)$$

in which s is the distance from the origin of motion in metres, and t the time.

Curve I is a representation to scale of this equation, and does not in any way represent the real path of the point in space, which may be along a line of any kind, but it is simply a scheme of showing how far the point is from the origin at any time. To interpret this particular curve it is seen that the point starts at the origin and moves in the plus direction for 0.423 of a second when it comes to rest, and then reverses its direction, arriving at the origin again after one second. The motion is then in the opposite or negative direction from the origin and so continues till it comes again to rest after 1.577 seconds. It then returns to the origin and arrives there again after two seconds, and thereafter continues to depart from the origin in the positive direction. This is known as the space-time curve. The velocity with which the point moves is algebraically represented by the first derivative of s with respect to t.

$$\frac{ds}{dt} = v = 3t^2 - 6t + 2. \qquad (2)$$

But graphically the derivative is represented by the tangent of the angle, which a line drawn tangent to the space-time curve at any point makes with the time axis. Such a tangent is drawn at B, and its value is seen to be $+2$.* At this point an ordinate is drawn equal to $+2$, and this gives one point on the velocity-time curve, as the point D. Any number of points could be similarly found and a continuous curve drawn through them. This curve thus graphically determined is the same as a curve representing equation (2), and in this case is seen to be a parabola. To interpret curve II physically, beginning with the point E, it is seen that the velocity of the point just starting from the origin is equal to 2 and in a positive direction, and by moving along the curve it is evident that the velocity is decreasing. At the point N, where the curve crosses the axis, the velocity is zero, and the point at rest after 0.423 second, which was also evident from curve I. The velocity then becomes negative and reaches a maximum negative value after one second, and this occurs when the point, as seen by curve I, has returned to the origin. In this way many features are readily detected by the eye which would not appear evident at a glance from the equation.

(*To be continued.*)

* Due to the different units used on the horizontal and vertical axes, the real angle is not the same as it would be when drawn to equal scales, but the tangent of the real angle is always found by taking the ratio of the sides of a triangle, measuring the vertical side by the vertical scale, and the horizontal by the horizontal scale.

An Experimental Study of Electro-Motive Forces Induced on Breaking a Circuit.

BY F. J. A. MCKITTRICK.

(*Continued from page 778, last volume.*)

Fig. 5 (2) and (3) show "breaks" with brass and copper terminals respectively, in which the current is the same as in Fig. 4, but the spring of the circuit-breaker weaker. The spark in (2) lasts longer than one ninth of a second, so that its ending is not recorded in the plate. In (3) the terminals are of copper, and the spark again ends more quickly than with brass terminals.

Fig 5 (1) shows a "break" with brass terminals, the current being only 1.5 amperes, while other conditions remain as in (2) and (3).

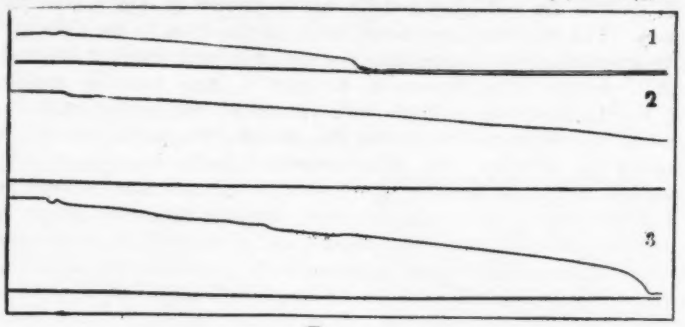


FIG. 5.

The current curves just discussed can, however, be only accepted as illustrative of one method of breaking the circuit.

It is clear that in order to follow theoretically the instantaneous values of the induced currents in the form of circuit shown in Fig. 6 when a is broken, the current curve during the break should be known. Since, in general, this curve is not known, it is only possible to consider particular cases. Let us examine, then, what occurs under perhaps the simplest conditions which can be imagined.

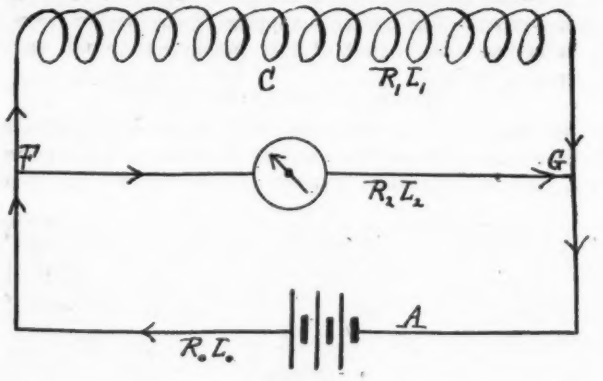


FIG. 6.

Consider the circuit in Fig. 6. Let R_0 L_0 be the resistance and self-induction of the branch a, and let R_1 L_1 and R_2 L_2 have the same meaning for c and b respectively. Let L_0 be zero, for simplicity, and $L_1 > L_2$. During the break in a, we shall have three sources of E. M. F. in this circuit, viz., the E. M. F. of the battery a, which we shall call e, and the two E. M. Fs. of self-induction; one in c and one in b. Let us think of the current produced in any

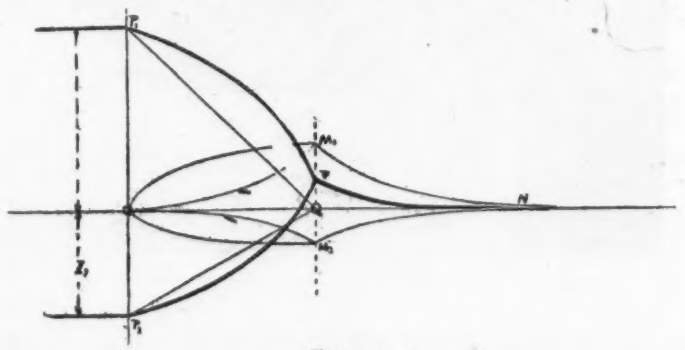


FIG. 7.

branch by each E. M. F. as separate from that produced by each of the others. The resultant actual current at any instant in any branch will be the resultant of the three hypothetical currents gener-

ated respectively by the three E. M. Fs. That it is legitimate to think of each E. M. F. as generating its own current independent of the action of other E. M. Fs. in the circuit, is evident when we consider that the solution of any differential equation for the current in a circuit in which there are several sources of E. M. F. results in an expression involving the sum of different terms, each term representing the value of a current produced by a corresponding E. M. F.

Let the current due to e be I_0, dividing into I_1 through c and I_2 through b. Let I_1^1 be the current produced by the E. M.F. of self-induction in c, and dividing through the branches b and a, and let R_1^1 and L_1 be the equivalent resistance and self-induction of the path of this current. Let I_2^1 be the induced current in b, and L_2^1 R_2^1 the equivalent self-induction and resistance of its path.

Suppose now that when a is broken, the character of the break is such that I_0 decreases uniformly during T the time of duration of the spark. If we plot currents as ordinates and times as abscissæ in Fig. 7, we may represent the decrease of I_1 and I_2 by the straight lines $p_1 q$ and $p_2 q$ respectively, where $o q$ represents T the time of the duration of the spark.

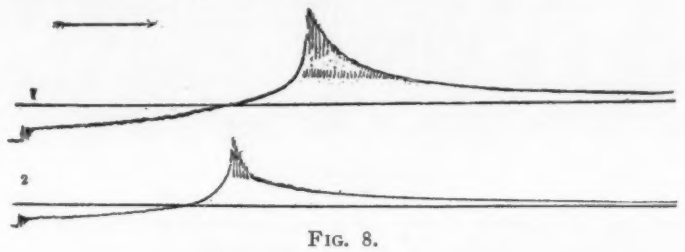


FIG. 8.

We have during that time T, $L_1 I_1$ lines of force in the field or c, due to I_1, uniformly removed, and hence we have a uniform E. M. F. acting in the circuit c during that time, equal in magnitude to $\frac{L_1 I_1}{T}$. At any instant, then, we have for instantaneous value of the induced current

$$i_1^1 = \frac{E}{R}\left(1 - e^{-\frac{R_1^1 t}{L_1^1}}\right) = \frac{L_1 I_1}{T R_1^1}\left(1 - e^{-\frac{R_1^1 t}{L_1^1}}\right),$$

and if R_1^1 and L_1^1 were constant, i_1^1 would increase according to a logarithmic curve.

Now R_1^1 is not even approximately constant. For

$$R_1^1 = R_1 + \frac{R_0 R_2}{R_0 + R_2},$$

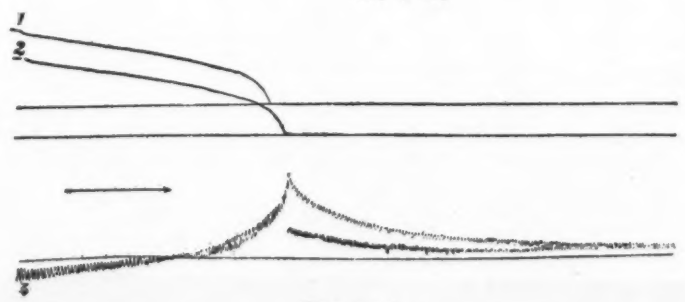


FIG. 10.

and R_0 is increasing rapidly. I_1^1 may be represented, then, by some curve $O M_1$, whose form will vary with the character of the spark, rising to a maximum at the end of the time T, and from the point M_1 dying away according to a logarithmic curve $M_1 N$, whose equation is

$$i_1^1 = i_1^1 \text{ max.} \times e^{-\frac{R_1 + R_2}{L_1^1} t}.$$

Similarly, we can represent the induced current I_2^1 in b by the curve $O M_2$, during the time of the spark, and $M_2 N$ afterward.

The current through c, at any instant, is the resultant of I_1, and I_1^1, at that instant, and the part of the current I_2^1 which is then flowing through c. Denoting the instantaneous value of this resultant current through c by i_c, we have

$$i_c = i_1 + i_1^1 - \frac{R_0}{R_0 + R_1} i_2^1.$$

From this equation we see that since, by assumption, $i_1^1 > i_2^1$, i_c will always be positive. When $i_1 = 0$, then we have $\frac{R_0}{R_0 + R_1}$ unity, and $i_c = i_2^1 - i_1^1$. From that instant at any time t

$$i_c = (i_1^1 - i_2^1)_{\text{at end of time } t} \times e^{-\frac{R_1 + R_2}{L_1^1} t}.$$

If the curve $O m_2 M_2$ represents the proportion of i_2^1 which flows through c, i_c may be plotted by adding at each instant the co-ordinates of the curves $O M_1 N$, $P_1 Q$ and $O m_2 M_2$ taken with their proper signs. The resultant curve for the current flowing in c will be $P_1 P N$.

Similarly for i_b, the instantaneous value of the resultant current in b, we have

$$i^b = i_2 + i_2^1 - \frac{R_0}{R_0 + R_2} i_1^1.$$

Since i_1^1 is increasingly greater than i_2^1, this equation shows that i_b gradually decreases and that at some time when

$$i_2 + i_2^1 = \frac{R_0}{R_0 + R_2} i_1^1$$

i_b is zero. After that i_b is negative and gradually increases to a maximum at the end of the time T. i_2 is then zero, R_0 infinite, $\frac{R_0}{R_0 + R_2}$ unity, and $i_b = i_2^1 - i_1^1$. From that instant i_b decreases to zero according to the curve,

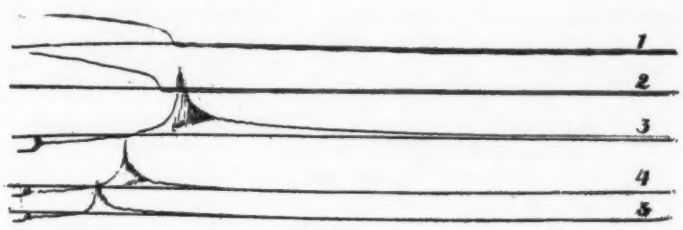


FIG. 9.

$$i_b = (i_2^1 - i_1^1)_{\text{at end of time } t} \times e^{-\frac{R_1 + R_2 t}{L_2^1}}.$$

After the ending of the spark, we thus have i_b equal in magnitude to i_c. If

$$\frac{R_0}{R_0 + R_2} i_1^1$$

is represented by the curve $O m_1 M_1$, i_b will be represented by the curve $P_2 P N$ whose ordinates at any instant will be the sum of the ordinates $P_2 T$, $O M_2 N$ and $O m_1 M_1 N$, taken with their proper signs.

It has been difficult to obtain photographs of I_b which are distinct enough to reproduce for publication. For the current curve is irregular, and since the needle possesses some inertia, the very sudden changes in the current produce vibrations which are difficult to photograph. It has therefore been necessary, in order to reproduce the faintest of these curves, to print from positives on bromide paper and sketch in the outline obtained.

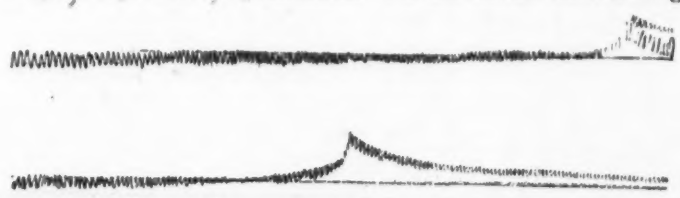


FIG. 11.

Fig. 8 (1) (2) show current curves for the branch b, reproduced in this way. The curves are traced from right to left. The straight part of each curve at the beginning is the steady deflection of the needle from zero, representing the current flowing before the break. This deflection was to the left, and hence appears below the zero line, as viewed in Fig. 8. The point where the break begins is clearly marked by a sudden deflection toward the zero line. From that point the curve dies away to the zero line, crosses it, rises to a maximum on the other side, and from there falls to zero by a curve logarithmic in form. The marked vibration of the needle at or near its point of maximum deflection is striking, and shows that at that instant the current suddenly changes in magnitude.

From the curves obtained in Fig. 7, we see that the current curve for b undergoes such a change at the point p, where we have supposed the spark to end, and we therefore might conclude that

these violent vibrations of the needle in Fig. 8 would mark the ending of the spark in the branch *a*. This conclusion is supported by Fig. 10, in which (3) represents another current curve for the branch *b*, while (1) and (2) show current curves for *a* and *c*, which were obtained by shunting the galvanometer across a non-inductive resistance, of 3.385 ohms, first in the branch *a*, and then in the branch *c*, the branch *b* being kept complete and of the same resistance as when the galvanometer was in it. Since these photographs were obtained consecutively and not simultaneously, and since it is doubtful if two sparks can be obtained of exactly the same character, these curves cannot be rigorously compared. Considering the variable nature of a spark, the close agreement between the time at which the spark ends in *a* and *c*, as shown in (1) and (2), and the time at which the marked disturbance of the needle occurs in *b*, as shown in (3), justify the above conclusion. Fig. 9 (1) (2) (3) show another such group in which the agreement is not so exact.

In comparing (2) and (3) Fig. 10, the current curves for *c* and *b*, it might appear that after the break I_c is zero, while I_b clearly does not reach zero for an appreciable time. But we have seen that after the break, I_c and I_b have the same value! The explanation of this apparent inconsistency is found in the fact that the scale to which

Fig. 12.

I_B is traced is 20 times as great as that to which I_c is traced, and hence a current which is represented by a considerable ordinate in the one case, is scarcely noticeable in the other.

Figs. 11 and 12 illustrate the effect on I_b of change in the E. M. F. in the branch *a*, the current I_0, and speed of breaking being kept constant. In Fig. 11 (1) *E* is 300 volts, in (2), 170 volts, and in Fig. 12, 58 volts. In the first case, the spark lasts .115 second; in the second, .066 second, and in the third, .018 second. The height to which I_b rises decreases as *e* increases, being .4, 1.25 and 1.4 cms above the zero line in the three cases, respectively.

Since the resistance of the branch *b* was very large compared with that of *c*, the one being 1.570 ohms and the other 5.815 ohms, and since its self-induction was negligible, the current through the galvanometer *b* may be taken as a measure of the difference of potential between the points *f* and *g* (Fig. 3). Since this potential difference after a short time is largely due to the induced E. M. F. in the branch *c*, and, after the break, wholly due to it, the current curve for *b* may be taken as indicating the variation of this induced E. M. F. during the break, and as approximately representing it in magnitude.

From the curves shown above we gather that the arc formed by a break is exceedingly variable in character and duration, and that the E. M. Fs. induced by the break vary with the arc formed.

We note that (*a*) the duration of the arc depends upon:

First. The current flowing at the instant of break. The variation of the duration of the arc with the current, as calculated from Figs. 8 and 9 (Table 1), is shown graphically in Fig. 13.

Second: The E. M. F. of the battery in the branch *a*. An increase of the battery E. M. F., other things being equal, always increases the duration of the arc.

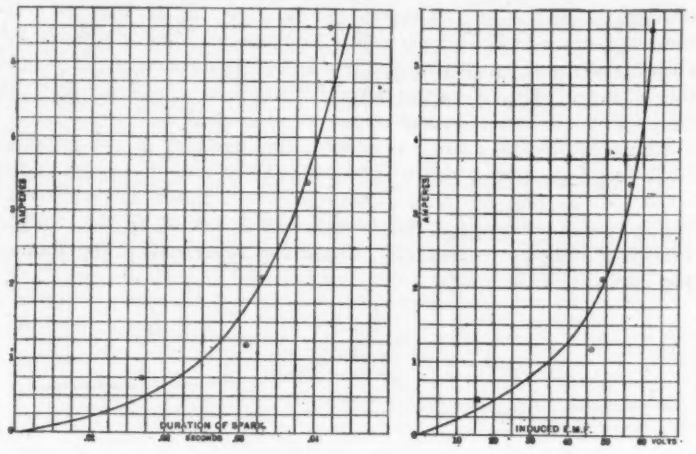
Third: The speed at which the terminals of the circuit-breaker are separated. Increase in the speed at which the terminals of the circuit-breaker are separated hastens the destruction of the arc.

Fourth: The metals of which the terminals are composed. We have seen in Figs. 4 and 5 that a break by copper terminals is of shorter duration than a break from brass. A break with zinc terminals does not seem to differ greatly in duration from a similar break with brass.

(*b*) The character of the arc formed varies, of necessity, with any condition that affects the duration of the arc. In particular, however, zinc terminals seem to produce a very irregular arc.

(*c*) The E. M. Fs. induced by the break, as indicated by the induced current flowing through *b*, vary also of necessity with any condition that affects the duration of the spark. The maximum induced E. M. F. varies with:

(1) The current flowing at the instant of break. From Figs. 8



Figs. 13 and 14.

and 9, as tabulated in Table 1., Fig. 14 is plotted, showing the variation of maximum induced E. M. Fs. with the current.

TABLE 1.

No.	I_0 Amperes	*E* Volts.	Terminals of Circuit Breaker.	Duration of Spark, Seconds.	Maximum P. D. at points *F* & *G* Volts.	Maximum Current Flowing Through *B* Amperes.
Fig. 4 (1).....	5.2	170	Copper	.065	—	—
" (2).....	5.2	170	Brass	.075	—	—
" (3).....	5.2	170	"	.068	—	—
Fig. 5 (1).....	1.5	170	"	.066	—	—
" (2).....	5.2	170	"	—	—	—
" (3).....	5.2	170	Copper	.115	—	—
Fig. 10 (1).....	4.2	125	Brass	.055	—	—
" (2).....	4.2	125	"	.057	—	—
" (3).....	4.2	125	"	.057	40.5	.027
Fig. 9 (1).....	2.1	125	"	—	—	—
" (2).....	2.1	125	"	—	—	—
" (3).....	2.1	125	"	.031	49.5	.033
" (4).....	1.2	125	"	.026	46.5	.031
" (5).....	.75	125	"	.015	25.5	.017
Fig. 8 (1).....	5.5	125	"	.047	62.0	.042
" (2).....	3.4	125	"	.061	57.0	.038
Fig. 11 1).....	2.25	300	"	.115	15.0	.010
" (2).....	2.25	170	"	.066	45.9	.030
Fig. 12 (1).....	2.25	58.5	"	.018	51.0	.034

(2) The E. M. F. of the battery. The variation is shown in Table 1. An increase of E. M. F. prolongs the duration of the spark and prevents a high induced E. M. F.

(3) The speed of breaking. Owing to the vibrations of the needle, the height to which the curve actually rises is difficult to determine.

Fig. 15.

Fig. 16.

There seems to be very little difference, however, between these curves in this respect. Other experiments, however, show that the maximum induced E. M. F. increases with the speed of breaking.

During the past Winter experiments were made with the aid of Mr. W. J. Lester to determine the E. M. F. induced in the field of a motor when the current flowing through it is broken. The motor used was a Thomson-Houston, No. 3322, Class 30 R. 500 volts. The field coils in parallel had a resistance of 2.05 ohms, and a self-induction of 1.15 henry. The arrangement of apparatus was the same as in the experiments just described, the current being supplied from 100-volt

mains. The galvanometer was placed in series with a resistance of 9500 ohms, and calibrated as a voltmeter.

The electromagnet, used to blow out the arcs, consisted of 100 turns of No. 18 B. & S. copper wire, wound on wrought-iron pole-pieces about 25 cms in diameter, on which were mounted tapering pole-tips. This magnet had been previously calibrated in the laboratory, but since it was inconvenient to place the terminals of the circuit-breaker directly between pole-tips, the strength of the magnetic field could only be estimated very approximately. During the experiments the strength of the field varied probably from 1000 to 3000 lines per sq. cm.

Fig. 15 shows the form of curve when the plate is dropped slowly and the arc blown out by a magnet. *I* is 12 amperes, and the duration of the spark .03 second approximately. The induced E. M. F. rises to 500 volts.

Fig. 16 is a similar curve obtained when *I* is 11.5 amperes and

FIG. 17.

the strength of the magnetic field increased. The short duration of the spark and the violent ending are noticeable.

Fig. 17 illustrates a very irregular break. A number of curves were obtained of this form when the resistance in series with the voltmeter was 33,000 ohms. Further investigation is required to determine the cause.

The results presented in this paper must be accepted as illustrative of the method of experimentation adopted, and as outlining problems, which the writer hopes to be able to investigate further. Besides a further investigation of the points already discussed, other equally interesting problems present themselves for solution, such as the effect of breaking from the surface of liquids, the effect of the form of terminals used, and the variation of the current curve in each branch of this circuit, as the relation between the resistances of the branches is varied.

The Standard of Light.

To the Editor of The Electrical World:

SIR:—I believe it to be the duty of all manufacturers of incandescent lamps to aid in calling public attention to the present extremely unsatisfactory state of commercial photometry with respect to the incandescent-lamp industry, and that manufacturers should co-operate in every possible manner with the American Institute of Electrical Engineers, and the National Electric Light Association, who are now attempting to determine upon a standard.

Owing to the present lack of uniformity with respect to a standard of light and photometric apparatus, and neglect of the variable factor introduced by the form of filament, and its position with relation to the standard during measurement, photometric results arrived at in different lamp factories are not always comparable, even when the integrity of the manufacturer is unquestioned. This lack of uniformity gives rise to disputes even among the well-informed and, in addition, places every opportunity before the unscrupulous manufacturer, who is thus able to put upon the market lamps of inferior candle-power and economy, since there can be no authoritative check upon the practice.

Bearing in mind that a considerable source of loss in the manufacture of lamps is occasioned by the variation of the voltage required by the product, necessitating culling in order that lamps should not fluctuate beyond a small percentage from their rated voltages, and furthermore, that photometric measurements made in good faith by competent observers, but with different apparatus, may vary 25 per cent.—with these considerations in view it is not difficult to appreciate the advantage that may be taken of the present situation by manufacturers so desiring.

To produce a condition more satisfactory to manufacturer and consumer, the real desideratum would seem to be not so much highly scientific method or apparatus of greater intrinsic precision as it is the employment of an empirical standard, if need be, but at any rate, one laid down by an authoritative body; and the means to arrive at the desired end could be such as to permit of application by the central-station superintendent and large user, thus placing in their hands a check on possibly dishonest practices, which, while protecting their own interests, would also safeguard those of reputable manufacturers. The requirements therefore would seem to be as follows:

First: A definite standard of light.

Second: A standard photometric apparatus simple of manipulation.

Third: A code of rules so constructed that by mechanically following its indications comparable results may be obtained by an intelligent observer without his necessarily possessing any knowledge of the principles of photometry.

The first requirement might be met by an authoritative body deciding upon a source of light, such as the Hefner-Alteneck lamp in a definite form, and by laying down rigid conditions in regard to the manner in which secondary standards are to be obtained from it. In case an authoritative body took such action many colleges and laboratories would, without doubt, willingly arrange for the supplying to the public of secondary standards, calibrated according to the standard thus set. Such a primary standard would be made so as to have its maximum degree of accuracy at, say, 16 candle-power; moreover, it would not be necessary that it should measure, say, 16 candle-power in absolute measurement, but merely that under the rigorous conditions to be observed, the result given by any one standard should accord with that given by all others.

The second requirement would be met by the same body, laying down rigid specifications for a simply manipulated photometric apparatus, so constructed as to have a maximum efficiency at, say, 16 candle-power, and so calibrated that its scale reading shall include all corrections necessary, such as for effective centre of light; the apparatus to include a mechanism for turning the secondary standard and lamp, under test, at such a rate as to produce the effect of uniform illumination in any given horizontal plane.

The third requirement would be met by a code of rules, rigidly prescribing the conditions under which a test should be made, the different steps being held in natural order, and the directions expressed in such simple and concise manner that not one versed in photometry could, by mechanically following its indications, make a test with the probability of obtaining an accurate result.

It will be readily seen from the foregoing that the attainment of the object in view is dependent upon a body of high authority and disinterested position taking the matter in hand, and the American Institute of Electrical Engineers unites to a high degree these qualifications. The object, also, it would seem, is clearly within the scope of such a body, being somewhat similar in character to that on which the American Society of Mechanical Engineers took favorable action when it was petitioned to lay down a definition of what would constitute a horse-power in the rating of boilers, and asked to prescribe a code of rules for boiler testing.

This subject should be of the utmost interest to all manufacturers who desire to have their product on an exact comparable plane with others, and whose efforts should ever be to seek to discountenance those who might desire to put forth lamps that did not in full measure give forth the light and efficiency claimed.

I should be glad if THE ELECTRICAL WORLD would invite all manufacturers to pledge their best endeavors to bring about an acknowledged standard of light. CONVERSE D. MARSH.

NEW YORK CITY.

International Congress of Electricians.

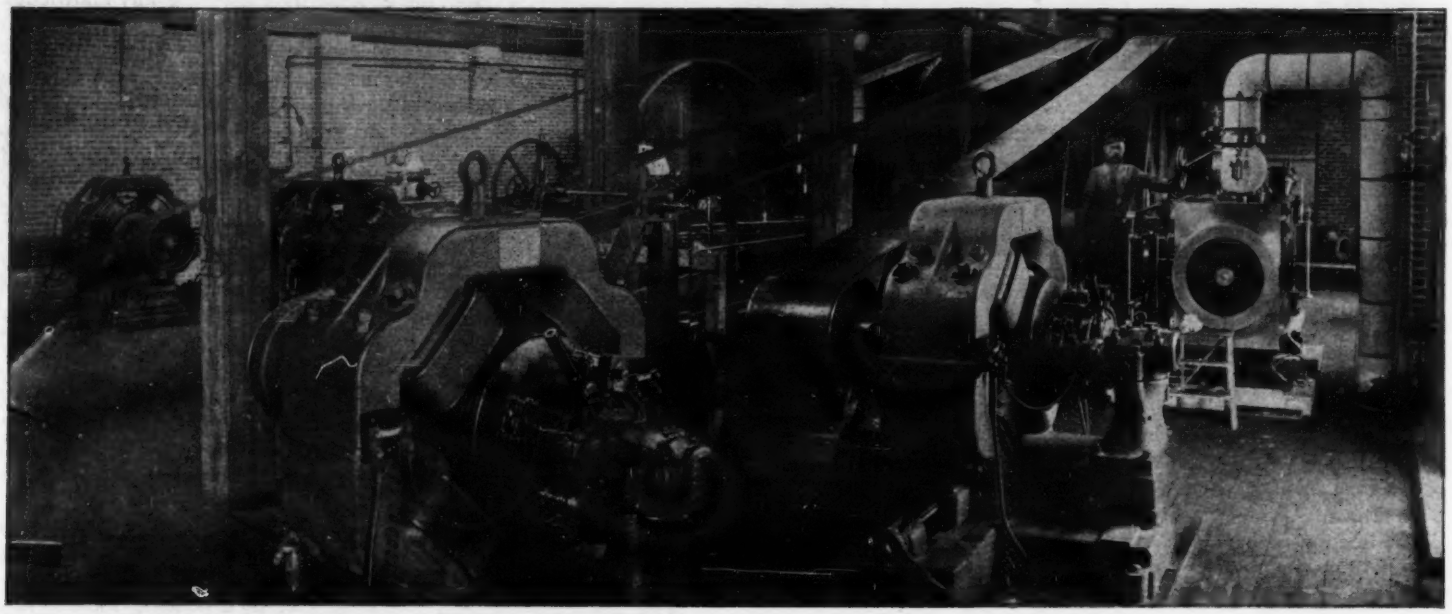
We have already noticed in our columns the coming meeting of the International Congress of Electricians, to be held in Geneva from the 4th to the 9th of August, 1896. We have recently received a programme of the proceedings. It is requested that those desiring to participate in the proceedings, either by presenting a paper or taking part in the discussion, would make known their intention before July 20. The price of the ticket for the congress, which includes everything set down on the programme, excepting the option of excursions, and in addition all publications, have been fixed at 20 francs ($4). Information relative to the congress will be given to all who inquire of the office of the International Electrical Congress, Université Geneve.

THE ELECTRIC RAILWAY

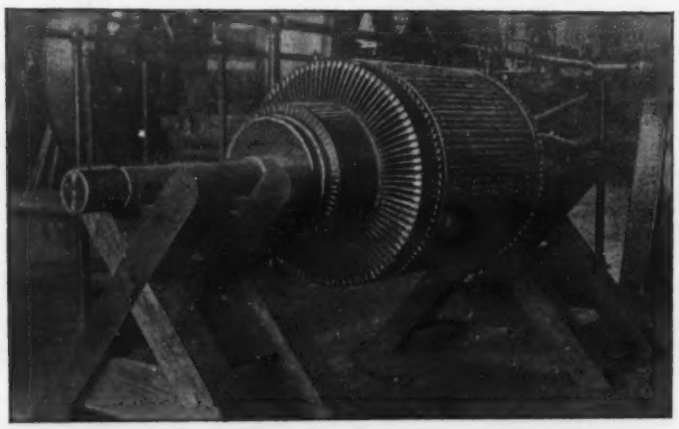
Elmira Street Railways.

The street railways of Elmira are now under the control of two companies, one known as the Elmira & Horseheads, and the other as the West Side Railway Company. The former, which has a mileage of 15¾, is at present operating from 12 to 15 cars, current being supplied by the Elmira Illuminating Company, and for which the railway company pays a stipulated sum. The power-house is built of brick, has a steel roof, and is a splendid structure of its kind. It was designed, however, in the pioneer days of electric lighting and street railway practice, and contains therefore several machines of the older type, occupying considerable floor space for their corresponding output. The station is amply large to allow for an increase in the power plant, especially with the installation of large units of modern construction.

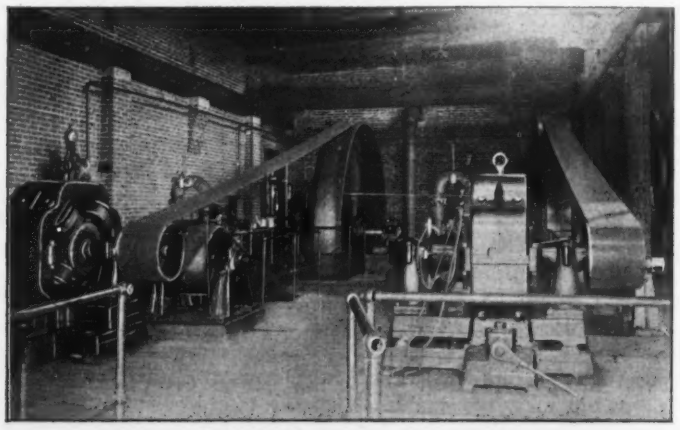
The boiler equipment consists of four vertical Payne boilers, of the multi-tubular type, and one of Babcock & Wilcox construction, each rated at 250 horse-power. Good coal facilities are at hand, cars being switched from the Delaware, Lackawanna & Western and the coal piled near the boiler room to which it is transferred by small cars, which are also used for conveying ashes. About 90,000 pounds of Eureka soft coal are consumed every 24 hours. The depth of coal on the grates of the Payne boilers is about 16 inches, and is an ordinary spread fire. Being fired in heavy charges it is allowed to coke, and then broken up by a splice bar. The grate under the Babcock & Wilcox allows of the coking process of firing. The steam obtained from the vertical boilers being super-heated about 16 degrees is of course thoroughly dry. Until lately considerable trouble was experienced due to scaling, and Mr. J. B. Cahoon, superintendent of the station, upon assuming charge immediately took precautions to prevent this evil by sending samples of the scale to chemists for analysis. The scale was found to contain principally magnesia, with other substances, and upon these tests a compound was made, which effectually eliminates the trouble, causing the foreign matter to be held in suspension and deposited on the pipes as a thin sludge. It, however, does not bake on, and therefore by frequently blowing off, the tubes are always kept in a clean condition. The Babcock & Wilcox boiler is provided with the ordinary brick setting, while the vertical boilers are covered with magnesia. The steam from the boilers is first sent through a Hoppes live steam purifier, no economizer being used. The stack is of steel, brick-lined and 156 feet in height. It was built by the Philadelphia Engineering Company, and is an excellent example of this type of construction. Feed and condensing water, which is supplied from a neighboring pond, first runs into a large tank situated under the floor of the pump-room, then passes through the purifier. The steam is delivered through magnesia-covered piping into a long header from which a tap-pipe supplies the engines. The header is suitably supplied with valves, and can be fed from either end, thus making the chances of a shut-down due to bursting a steam pipe quite as small as though a duplicate system of piping were used. The steam gauge pressure is 150 pounds per square inch. There are two feed pumps in the pump-room, and one Kortings injector. The pumps have a capacity of 6000 gallons per hour, and a double system of feed-piping is provided. Owing to the dryness of the steam delivered no separators are necessary.



Engine Room, West Side Railway.



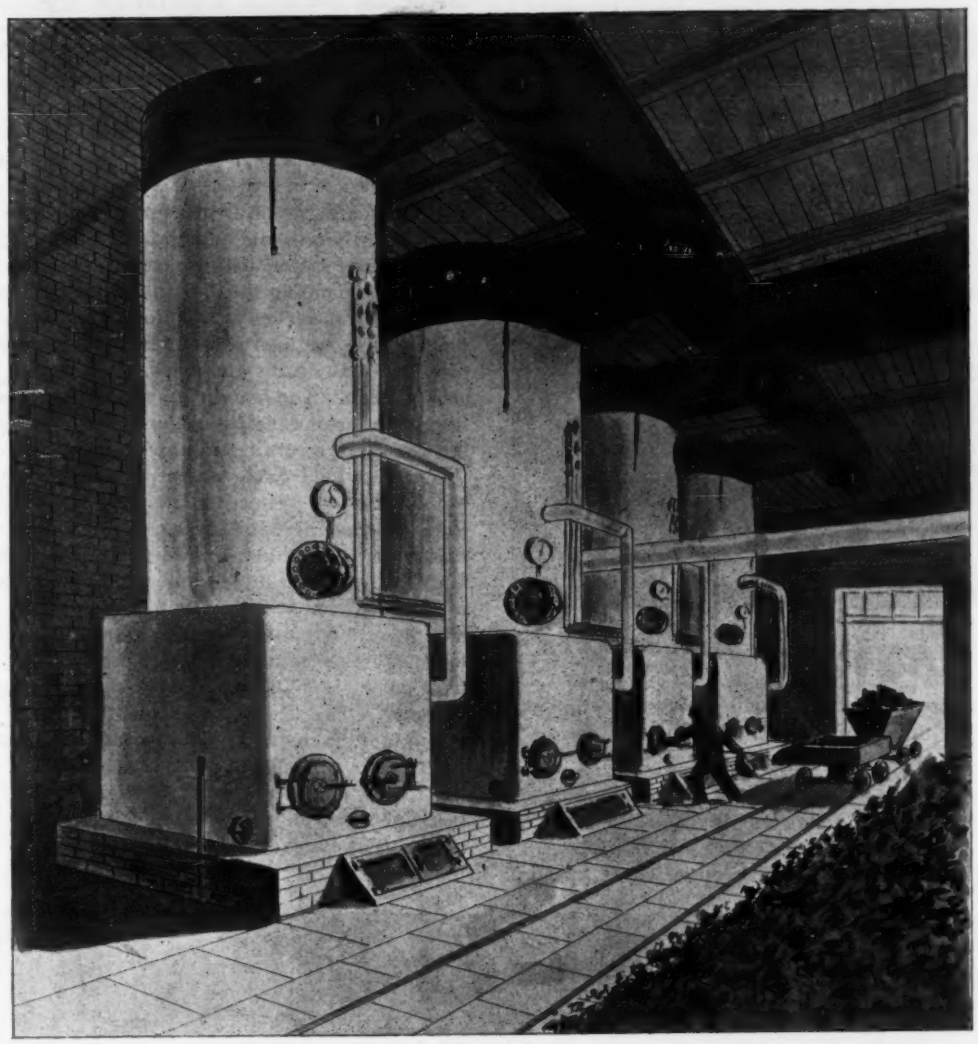
Armature.



The Two Small Units, West Side Railway.

Two of the engines are of the McIntosh & Seymour type, are tandem-compound, run at 138 revolutions per minute, and have a stroke of 17 inches. The cylinders are of 13 and 23 inches respectively; each engine is rated at 350 horse-power, and with the exception of a

slight difference in the fly-wheels, they are exact duplicates. The engines are placed so that their shafts are in line, and are connected by a jack-shaft which carries pulleys and friction clutches supported on suitable bearings. The jack-shaft and clutches were supplied by a well-known Fall River firm; the dynamos are directly belted to the jack-shaft and fly-wheels of the engines, no idlers being used. Two Edison bipolar 75-kw generators are each driven by a 22-inch double-ply leather belt; another generator, of the Westinghouse type, is a multipolar machine of 150-kw capacity. This machine is illustrated below; it runs at a speed of 535 revolutions per minute. The general construction of the armature is shown on page 14, which is a photograph of a spare armature held in reserve, to be used in case of failure of the one now running.

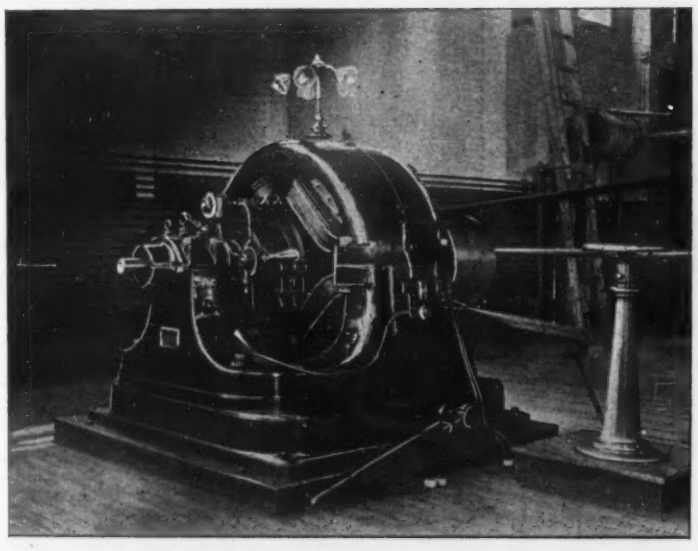


BOILER ROOM, ELMIRA & HORSEHEADS ELECTRIC RAILWAY.

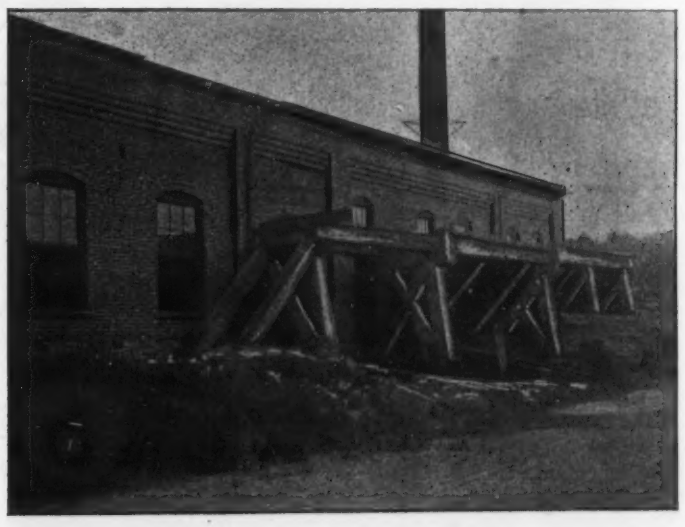
The engine exhausts into a Blake jet condenser, the water being pumped by a Blake air-pump into a hot well; in case of necessity exhaustion into the atmosphere has been provided for. The switchboard is of marbleized slate, is of the ordinary type and contains the customary instruments; each machine is provided with a circuit-breaker, rheostat, ammeter and the necessary switches; the circuit-breakers are of the Westinghouse type, with the exception of one, which was made by the General Electric Company. The latter takes care of the entire railway load. The wiring, which is entirely on the back of the switchboard, is connected to cables passing under the floor to the generators. Seven feeders supply the line, and vary from No. 000 to No. 0.

Switches on the poles control the feeder system, which is divided into three electrical sections; the trolley wire is No. 0 B. & S.; double bonding of the rails, by means of the Chicago rail bond, is employed, and thus far no trouble due to electrolysis has been experienced. On some of the lighter rails a No. 0 copper bond and channel-pin is used. The rails are partly 9-inch, 90-pound girder, and partly 6-inch 78-pound girder; there are also some 38-pound T-rails, and some 52-pound girders. Some were rolled by Wm. Wharton & Co., and some by Johnson & Co. Oak ties, 6x6 inches and 8 feet long, are used. Most of the rail joints are ordinary fish-plate, but in some cases the Stever joint is found. Owing to the antagonism of the steam railway companies, it has been necessary to use the ordinary jump crossing.

There are now in use 18 closed cars, 6 open cars and 7 trailers, all but two of which were built by the John Stephenson Company, the others by Jackson & Sharp. Many of them are mounted on the Stephenson wooden truck. Three cars are provided with Brill trucks and a few with the Chicago and also the McGuire Vestibules are used in the Winter time, although not compelled by legislation. Various types of motors are to be found on the cars, including the old S. R. G. type, several Edison H., Westinghouse 3 and Westinghouse 12, and



FOUR-POLE GENERATOR, ELMIRA & HORSEHEADS RAILWAY.



COAL SHUTE, WEST SIDE RAILWAY.

General Electric 800. The controllers are the Sprague, Westinghouse and General Electric types.

The effect of the reforms introduced by Mr. J. B. Cahoon since

Power House, Elmira & Horseheads Electric Railway.

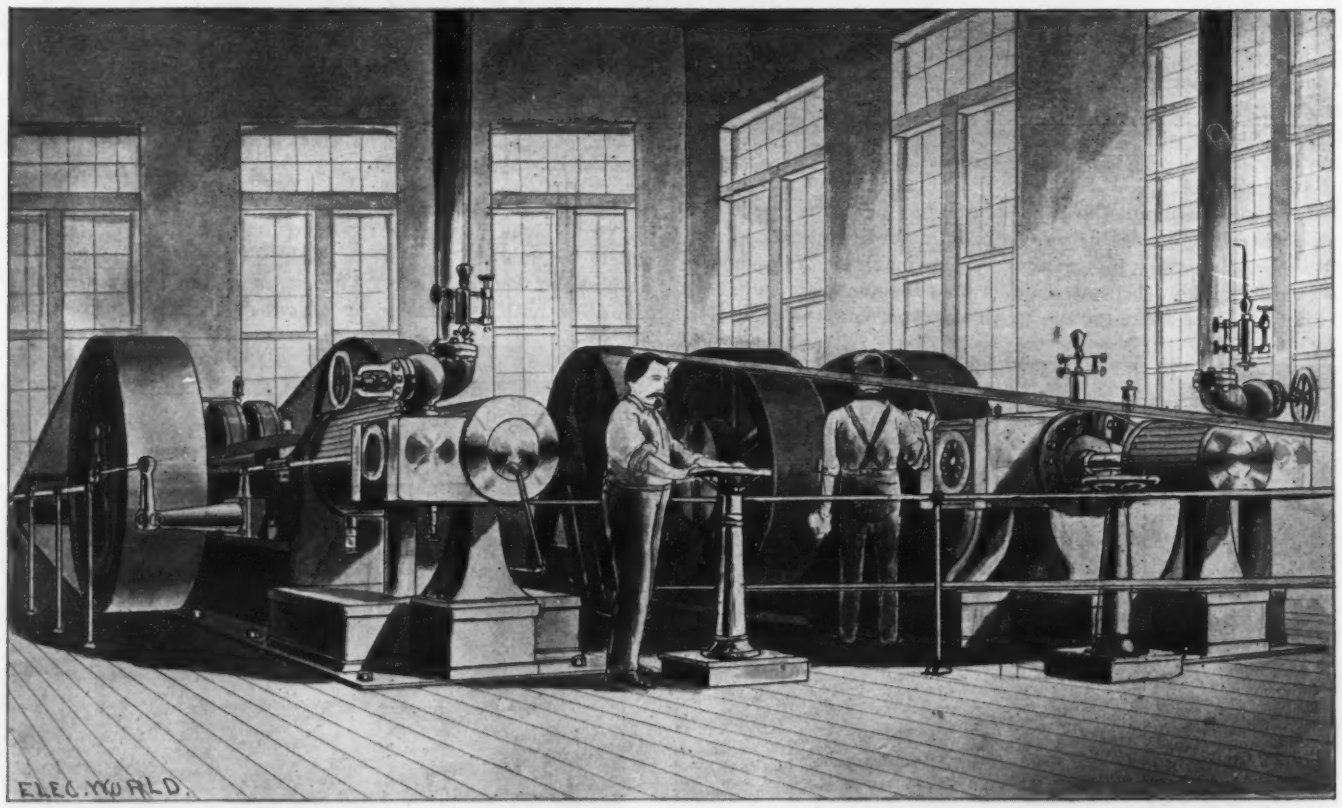
assuming control are noticeable, and the road, which now runs well, will compare favorably with any of its size.

THE WEST SIDE RAILWAY.

The second street railway in Elmira, mentioned above, is under the superintendency of Mr. W. W. Cole, and is sufficiently interesting in its equipment to warrant a complete description.

The power-house is situated on College Avenue, about two and one half miles from the centre of the city. The buildings consist of a main power house, containing the engines and boilers, and an auxiliary car-house and repair shop, together with a small sheet iron structure used as an oil house. An accompanying illustration represents a method employed of delivering coal. The New York, Lake Erie & Western track switches on an elevated structure running alongside the boiler-room, and by means of a slanting chute a full carload of coal may be dumped onto the boiler-room floor without handling. The boiler-room contains three boilers of 100-horse-power each, made by B. W. Payne & Sons, Elmira, N. Y. These are of the horizontal multi-tubular type, and are fitted with the Locke Bros. damper regulators, giving excellent regulation. About 10,600 pounds of soft coal are used a day. The coal is first coked on a dead plate, and then pushed forward under the boiler, where its complete combustion is effected. Facilities are at hand for readily changing the grates to utilize anthracite coal; the depth of fire is about eight inches. The ashes are wheeled out of the boiler room in large steel wheel-barrows. The boilers are set in the ordinary form of brick setting, and are provided with a steel stack 40 inches in diameter and 95 feet high; it is mounted on a concrete foundation and is stayed with guy-rods. A duplicate system of steam piping lined with magnesia covering is employed, the pipes being 10 inches in diameter, and passing along the front and rear of the engines and under the engine room floor; it is well provided with drains and drips. The steam gauge pressure carried is 95 pounds. The boilers are fed by two feed pumps, provision being made for passing the water either through directly, or by the heater; no injectors are employed.

Considerable trouble was at first experienced, due to scaling, but by blowing off frequently this difficulty is largely obviated. The Bates Corliss engines deliver the power, two of which are duplicate units rated at 135 horse-power each. They have 16-foot fly-wheels, and the cylinder dimensions are 16 x 42; each engine runs at 82 revolutions per minute; the larger engine is of 300 horse-power, having cylinder dimensions 24 x 48, and runs at 75 revolutions per minute. The smaller engines are belted by 16-inch double-ply belt each to a Thomson-Houston railway generator of 90-kw capacity. The 300-hp engine has two 16-foot fly-wheels, each weighing 10 tons, having a 24-inch face and are mounted on a 13-inch shaft; each runs a 16-inch three-ply Jewell belt, driving two General Electric 100-kw multipolar railway generators. All of the belts run over belt-tighteners or idlers, made by the Falls Rivet & Machine Company. The Bates-Corliss valve gear is said to work very well, and inasmuch as it is somewhat different from ordinary types of detaching-valve gear it may perhaps be worthy of a brief description.



Engine Room, Elmira & Horseheads Electric Railway.

Instead of the customary crab claw on the cut-off valve spindle, an ordinary valve crank is used which comes down to the wrist plate, on the back of which the detaching gear is mounted. The end of the connecting rod reaches from the valve crank to a second small crank on the wrist-plate, and which is on the dead point when

the wrist-plate draws the valve open. The lug projecting from this latter crank strikes against the knob controlled by the governor, throwing the small crank over the dead point, when it immediately loses its ability to pull the valve open, thus allowing the dash pot to fall. The knob which strikes the small crank is, of course, controlled by the governor. This arrangement is very ingenious, and as there are no parts to wear out, no change can occur in the adjustment. One of the smaller Bates-Corliss engines is fitted with an automatic stop to provide against racing. In principle it acts as follows: A heavy weight is attached to a cord which is wound about a drum, which being directly geared to a spindle, allows another cord to be wound up on the latter by the falling of the weight, thereby unwinding the cord of the spindle of the throttle-valve and closing it. By means of a pawl and ratchet the throttle can be operated by hand, irrespective of the automatic device; a little weight is held in position as indicated in the diagram, by means of a lug which is in turn held by the armature of the magnet. With increase of speed, thus increasing the voltage, the magnet attracts its armature, the weight W falls, releasing the pawl, and allowing the larger weight W_1 to fall and shut off the steam. At the same time a circuit is made through the lower magnet, and, in a precisely similar way, the weight W being caused to fall, strikes the lever, which in turn operates the trigger of the circuit-breaker. This device is said to work very well, and is made by the Elmira Appliance Company.

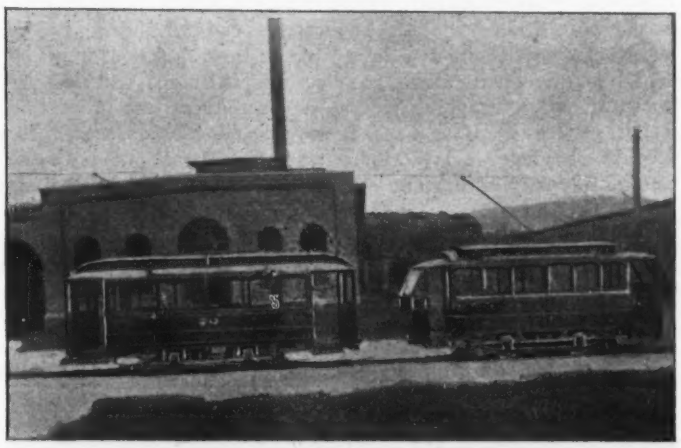
The engine exhausts into a Goubert feed-water heater, which, when cleaned, always contained a large amount of sludge, showing its effectiveness in stopping foreign matter and thus preventing scaling.

The generators are of the four-pole type, and have cast-iron field magnets. The smaller machines have ring-armatures, and the larger drum-armatures with spiral end-connectors; the latter are of 100-kw capacity. All machines are run in multiple, the equalizer being brought in by three-pole switches at switchboard; the normal speed of the large generators is 650 and voltage 515; the smaller generators running at 750 revolutions.

From the dynamos the feed and equalizer wires pass up through the rear of a slate switchboard, there connecting to the bus-bars. The switchboard is type H of the General Electric Company, and is provided with G. E. apparatus, including circuit-breakers, ammeters, rheostats, lightning arresters and voltmeter contacts; all but the voltmeter is of the T.-H. type.

There are four feeders, one of which is No. 0000, the rest of No. 00; the line is not sectionally arranged. No. 0 trolley wire is used; the circuit-breakers on the lines are set for 200 amperes. The trolley wire is fed into at every 500 feet.

The dynamo room is provided with two traveling cranes, built by Edwin Harrington & Sons, of Philadelphia. The rails mostly

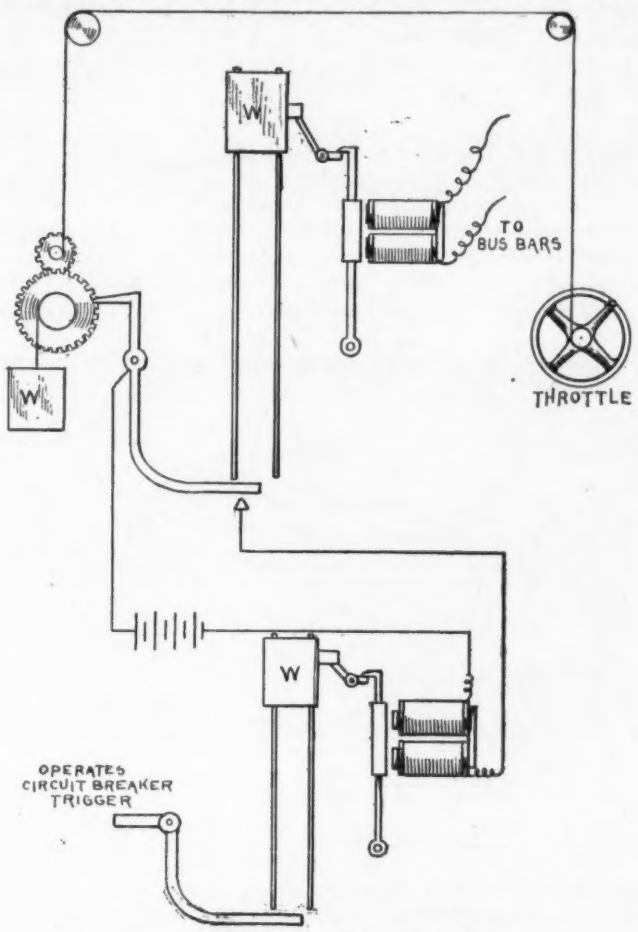


TYPICAL ROLLING STOCK. WEST SIDE RAILWAY.

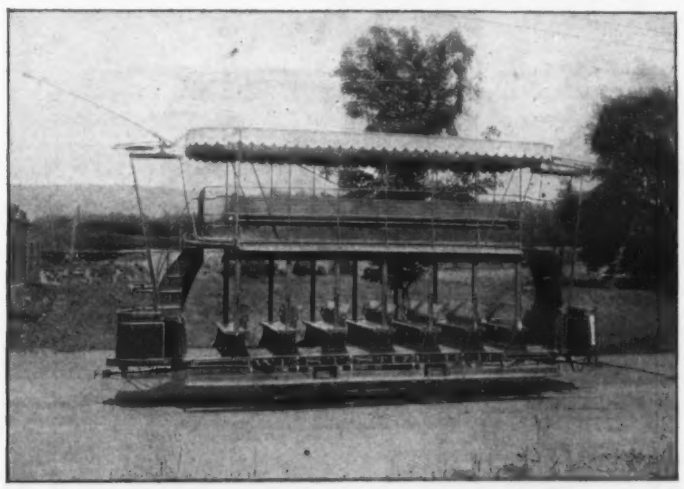
are girders of 70 and 90 pounds with some 50-pound T-rails. On the 50 and 70 pound rails the joints are double-bonded with single galvanized iron wire, and $\frac{1}{16}$ inch channel pin. The T 90-pound rails are double-bonded with No. 0 Chicago copper rail bonds. Oak ties 6 x 6 inches are the smallest in use.

The company is now operating seven open Brill cars, three double-deckers, three 12-bench, eight-wheel Brill, a large Jones trailer, six 16-foot Stevenson box, six 18-foot vestibule Brill, and one 20-foot vestibule car, making a total of 27; both standard and maximum traction Brill trucks are used, and a few Peckham; the cars are provided with G. E.-800 motors, and some W. P. thirties and fifties. Both Type E rheostat and Type K controllers are used. The road is about eight miles long.

A snow sweeper is employed, and tests show that the motors driving the sweeper take very nearly a constant current, while the motors operating the brushes require variable amounts from 70 to 120 amperes. Mr. Cole has issued a little code of rules, with which each of his men is supposed to be conversant; in this pamphlet he endeavors to carefully instruct the men as to the actual way in which the cars operate, and few of them are therefore unacquainted



AUTOMATIC ENGINE STOP. WEST SIDE RAILWAY.



DOUBLE-DECK CAR. WEST SIDE RAILWAY.

with electrical matters; each man is obliged to serve an apprenticeship in the power-house, and also 10 days in the repair shop, thus obtaining quite a fair knowledge of the equipment. Each conductor is required to furnish bonds to the amount of $200 for the faithful performance of his duties, the validity of the security being determined by the superintendent.

The cars are run on schedule time, and as a consequence little delay is experienced at the turnouts. Mr. Cole has in various ways materially increased the revenue of the road, where at first a deficit was threatened.

Waiting houses filled with comfortable seats have been provided at several corners, affording shelter from the inclemencies of the weather. At some of them newspapers and refreshments are served. In the opinion of the managers these waiting houses are extremely good investments, as they deter many passengers from taking the alternative of walking rather than using the cars. Mr. Cole is at present laying out a park system, which shall be the property of the company and to which the cars will run.

The Convention Hall at St. Louis.

The accompanying illustration represents a plan and general view of the building in which the American Street Railway Association will hold its next annual convention, beginning on Tuesday, Oct. 20, and continuing for four days. The building is the one recently used by the Republican National Convention, and the interior will be

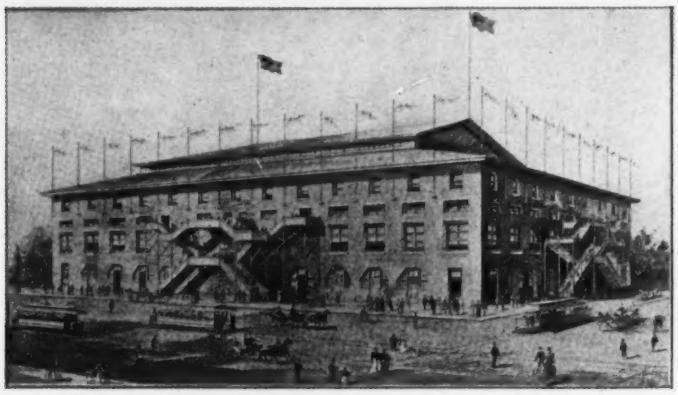


Fig. 1.—Convention Hall, St. Louis.

arranged to suit the requirements of the association. The ground dimensions are 180 by 260 feet, 80 feet in depth, being partitioned off to provide quarters in which the convention will hold its sessions, and thus leave a space of 180 feet square in which exhibitors will have an opportunity of displaying their goods. Current will be supplied at 550 volts.

The income from the sale of space reverts to the treasury of the American Street Railway Association. The price fixed is 10 cents per square foot for not less than 100 square feet. Applicants may have any number of 10 feet square allotments they may desire, limited of course to the total amount of available space at the disposal of the committee.

All applications must be in by Aug. 15, and assignments will be promptly made after that date and exhibitors notified of the spaces

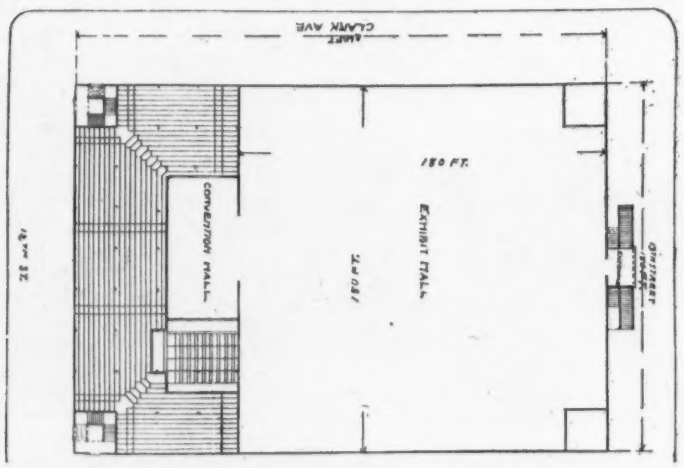


Fig. 2.—Plan of Convention Hall.

allotted. Possession of the hall can be had Oct. 1, and it is specially requested that all exhibits be completed by Oct. 19. As watchmen will be in charge, the safety of the exhibits will be thus assured. Owing to the fact that the success of the convention is largely dependent upon the exhibits, it is urgently requested that prompt application be made to obtain space. This will at the same time obviate the annoyance which always occur when the exhibits are not completed at the formal opening of the convention.

Applications for space should be made to the Chairman of the Committee on Exhibits, Mr. Geo. W. Baumhoff, Park and Vandeventer Avenues, St. Louis.

The Outlook for the Electric Railway.*

Mr. F. C. Armstrong, in a paper on "The Outlook for the Electric Railway," thinks that the street railway motor of to-day may be considered in view of the conditions under which it operates, limited space, exposed position, light weight and severe service, as a highly efficient and satisfactory machine. The controlling apparatus has been developed to an equally high degree of perfection, ensuring in the best types a maximum economy of current, and reduction of strain on the motors under varying conditions of operation, and even adding to its normal function the duties of an electric brake. In the power-house, the substitution for the small belt-driven generator, of the large, compact, slow-speed direct-connected unit, with its steel frame and ironclad armature, leaves little room for improvement in the way of higher efficiency, closer regulation or greater durability. Improvements in design and material have done much to remedy the unsightliness and unreliability of the devices used in overhead construction and the standard pressure of 500 to 600 volts is found, even for suburban extensions of considerable length, to be commensurate with a reasonable copper economy. From a financial point of view the position of the electric street railway is equally assured and satisfactory. No field for legitimate investment is now more favorably considered than that offered by the securities of a well-managed and well-equipped electric railway in a city or town of any size suitable to its capitalization. As evidence of the financial importance to which the electric street railway interests in Canada have attained, may be cited the fact that there are at present in operation, or being constructed in the Dominion, 36 electric street railways, having a total mileage of close upon 600 miles, using 750 motor cars, with a total generating capacity of 19,500 kilowatts, and representing an actual investment in round figures of over $20,000,000.

At this point, and at a meeting held in the City of Toronto, it is peculiarly fitting by way of contrast and as epitomizing the development of less than one decade, to quote from a catalogue issued nine years ago, in 1887, bearing the title "The Van Depoele System of Electric Railways," in which, under the heading, "Facts About Running the Toronto Electric Railway in 1885," we find the following:

"Plant consisted of one engine, automatic, 10 x 16 cylinder, 150 revolutions per minute; one electric generator, 40 horse-power; one electric motor, 35 horse-power; one motor car, weight, six tons; three passenger cars, each two tons. Average number of passengers carried, 83 per car; estimated weight of passengers per train, 16 tons; total weight of train, 11 tons; length of track, one mile (with one grade of six per cent.); average speed, 30 miles per hour; passengers carried in five days, 50,000; average consumption of coal per day of 10 hours, 1200 pounds; distance traveled in 10 hours, including stopping to take on passengers, 200 miles"

The generator in the case, it may be added, was a 40-light arc machine, having, it is stated, "an E. M. F. of 1300 volts, and an intensity of current of about 18 amperes," and the single motor, belted to the axle, was a 35-light machine of similar type. In the same catalogue we find a description of each of the Van Depoele roads in operation at the date of its issue. The list is a short one—Montgomery, Ala., 1½ miles; Detroit, Mich., 1¾ miles; Windsor, Ont., 2 miles; Appleton, Wis., 4½ miles; Port Huron, Mich., 3 miles, and Scranton, Pa., 2 miles, a total of 14¾ miles. It is amusing to note following this modest list of roads installed the bold challenge that, "as the matter now stands we have more miles of electric railway now in successful operation than all the other electric railways in the world combined."

Highway Crossing Alarms.

In a paper by Mr. G. L. Lang, read before the recent convention of the Association of Railway Telegraph Superintendents, at Fortress Monroe, Va., he states that "there are devices that will protect all of the crossings some of the time, others that will protect some of the crossings all of the time, but none that will protect all of the crossings all of the time."

* Abstract of a paper presented before the Toronto meeting of the Canadian Electrical Association.

DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE

BY CARL HERING

COMPILED FROM THE PRINCIPAL FOREIGN AND AMERICAN JOURNALS

DYNAMOS, MOTORS AND TRANSFORMERS.

Single-Phase Motors. NATHANS. *Elec. Eng.*, June 24.—A short, illustrated article describing the Fort Wayne motor. It starts under full load without the aid of external apparatus; the armature is of the ring type and carries two windings, one for direct currents, provided with the usual commutator, and the other having as many coils as there are field poles, and connected to suitable collector rings; the multipolar field has a thick and thin wire winding, the latter predominating; the starting current is passed through the commutator and the thick wire winding of the field, thus making it a simple series motor for that time; no rheostat is used for this, as the self-induction of the field coils is sufficient; a centrifugal spring on the shaft indicates by means of an incandescent light when the speed is slightly above that of synchronism, which is a signal to throw the switch which changes the connections and makes it an alternating-current motor, the continuous-current winding being then a generator and passing current through the fine winding of the field; the starting current is 25 to 50 per cent. in excess of that at normal load.

POWER AND HEAT.

Utilization of Water-Powers with Small Fall. STEIGER. *Elec. Eng.*, June 24.—The beginning of a reprint with the illustrations, of the recent Institution paper (see *Digest*, June 20 and 27).

Portable Electric Painting Plant. Elec. Eng., June 24.—A reprint of the article abstracted in the *Digest*, June 20.

Electric Heating. PUCHTA. *Elec. Eng.*, June 24.—An abstract of a paper read before the Chicago Electric Association; he discusses the subject of car heating and describes a method of connecting the heaters.

TRACTION.

Storage Batteries for Traction Purposes. ELIESON. Lond. *Elec. Rev.*, June 12.—Considerable doubt seems to exist as to the improvements which have been made during the past few years in storage batteries, especially for traction purposes; to show what he has done he states that in 1885 to 1887 he used cells weighing 76 pounds and having a capacity of 120 ampere-hours; he is now manufacturing them weighing 72 pounds and having an output of 360 ampere-hours; both were of the Planté type.

Dublin Three-Phase Railway Plant. Elec. Eng., June 24.—An illustration of the sub-station switchboard of this railway system; (see *Digest*, last week).

Surface Contact System. Elec. Eng., June 24.—An illustrated description of the Johnson-Lundell system (see *Digest*, last week).

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Electricity in Coal Mines. RAVENSHAW. Lond. *Elec.*, June 12.—An abstract of a recent paper read before the Institution of Mining Engineers. He describes the precautions necessary; electricity in lighting and power transmission in coal mines is becoming more general, and many of the plants have been running for years without any serious accidents or explosions, which have been due to its adoption; some writers claim that there is little or no risk of ignition of gas by the spark, but this he thinks remains to be proved, and he considers it much better to guard against any possible danger; he thinks the risks are few and easily guarded against, and that there is no reason why electric motors should not be used in the most fiery mines, if proper precautions are taken in the erection of the plant and in keeping it in a proper state of repair. To avoid shocks, all parts of the circuit should be covered, so that it is not possible to touch them without deliberately taking off the covers; the metal cases should all be permanently earthed; when parts must be handled while the circuit is alive, a sound, dry timber floor, with perhaps a rubber mat and a wooden hand-rail, are the best protection; preventing shocks is of importance, as the machinery is much more likely to be well looked after if the attendant is not afraid of touching it. In regard to conductors, he states, among other things, that if the shaft is wet the cable should be run in iron pipes having water-tight joints; where there is no water, armored cables may be used, care being taken to prevent them from being damaged; several schemes have been suggested and some have been tried for preventing a spark on the breaking of a cable, but none of these have been generally adopted, and he thinks it doubtful whether any such device can be relied upon if it depends on the accurate adjustment of comparatively delicate apparatus; he is greatly in favor of concentric cables of which the external conductor is earthed at frequent intervals, if not continuously; in damp places it may be necessary to cover the armor with insulated material; in some cases the return wire was uninsulated, which has the disadvantage that the chance of breaking down is doubled, but he thinks that this drawback is counterbalanced by the fact that defects at once show themselves; it seems impossible for the concentric cable to break down without the inner wire coming in contact with the outer, which would cut off the current. Branches and joints should always be made in cast-iron junction-boxes which are water-tight; switches enclosed in metal cases should be perfectly air-tight; the frames to which porcelain insulators are attached should be insulated; care should be taken with wire coil resistances so that they do not come in contact with each other or surrounding objects; water resistances are very suitable for starting motors, as they can be made so that there is no spark at the surface of the water; when there is only one motor both the motor and the dynamo should be series-wound; sometimes these series motors have been run in parallel and work well as long as the load is constant, but they tend to race; to prevent the induction spark from the magnets, a resistance is inserted in parallel with the magnet just before breaking, it being left in parallel so that the coil can discharge itself; series magnets should have a resistance permanently connected in parallel; he recommends belt or worm gearing for a reduction of speed, as distinguished from gear wheels; he favors the drum armature, for when short-circuited it stops at once, which blows the fuse, while with a Gramme winding the armature may continue to revolve, and will then be badly burnt; in fiery mines the armature and commutator are usually enclosed in gas tight covers; his experience with a large number of such motors is that when the covers are well made they afford ample protection; where compressed air is available a constant pressure could be kept up inside of the covers; the greatest safeguard against accident is good supervision and careful daily testing; alternating-current motors are not discussed.

Cost of Electricity Supply. WRIGHT. Lond. *Elec. Eng.*, June 12.—A paper read before the Municipal Electrical Association. He showed that at present there was no definite basis on which to calculate the cost of the electricity, many different systems being still in existence; he showed how a curve of the total monthly expenditures could be analyzed and fairly represented by an empirical formula; he showed the importance of separating the great cost of getting ready to supply, from the low cost of continuing the supply, and showed that there was a greater necessity for a differential rate in towns where coal was cheap than where it was dear; he described the (Wright) method which is used at Brighton and showed how the account would indicate which customers proved profitable and which did not; he considered it the duty of a municipality to charge on the basis of a uniform rate of profit than a uniform price; the extremely low price at which electricity can be supplied on the former basis more than compensates for its comparative complication; the initial price should be kept at the highest possible figure until the standing charges were covered and then reduced to as low a figure as possible; he thinks it easier to reduce the average cost by improving the load factor than by economizing coal; according to his system, streets could be lighted cheaper than by any other form of illuminant of the same candle-power. In the discussion, Mavor supported the differential rate of charging; he had devised a method which was simple but with which he was not entirely satisfied; he divided the total units per annum by the total number of lamps installed, which gives the average hours during which each lamp was used; charges were then varied by giving the following discounts: 1000 hours, 10 per cent.; 2000 hours, 20 per cent.; 3000 hours, 50 per cent.; with this system a profit could be shown when the charge was less than 6 cents per kw-hour; as to street lighting he thought that arc lamps could not compare with gas as to the cost, whereas incandescent lamps could compete. Sayers had adopted the Wright system of a maximum demand indicator, and found that the total value of the energy had increased in spite of the reduction of the rate to good consumers; he did not believe Mavor's system was at all feasible, as it tended to prevent the complete wiring of the premises. Ellis had also introduced a maximum demand system at Southport, which had been very successful. Proctor thought

the maximum demand indicator did not meet all the requirements of the case, as it took no account of the time when the load occurred; he believed it was better to encourage the day load; he had used the Kapp meter for differentiating the day and night loads, the only objection to which is that the "total unit supplied" was not indicated. Wright in reply showed that the flaw in the Mavor system was that a consumer had merely to use a very little more to get a great reduction in his bill; he discussed the question of debiting the whole of the wages to standing costs, arguing in favor of it.

Combined Lighting and Traction Plant. Rider. Lond. *Elec. Eng.*, June 12.—A brief notice of a Municipal Electrical Association paper, with the discussion.—It deals with increasing the day load of a lighting station by supplying railways with current; two systems are suggested; the first is to have one station containing two distinct plants and to economize coal and the staff required; the other is to use the lighting machinery for the railways and to provide for the overlapping demand by accumulators. The discussion is largely of local interest only; Ferranti agreed with others that there would be great difficulties in introducing such a combined system in London; he doubted whether railways could be supplied from the same mains without affecting the lighting service; motor transformers with heavy fly-wheels, he thinks, would overcome this difficulty, and accumulators would also assist; Worthingham advised the use of separate generating plants supplied from the same boilers; a number of the speakers agreed on the advantages of using a storage battery.

Wolverhampton. Lond. *Elec.*, June 12.—A long, well-illustrated description of this plant in which the system used is very much like the one known as the Oxford system; continuous currents of 2000 volts are used which is twice that at Oxford; the chief points in which it differs from the high-pressure continuous-current systems are: in the use of motor transformers between the high and low-pressure mains, as they have a higher efficiency than batteries; in the use of a smaller storage-battery plant for working the system when the load is very low; in charging the sub-station batteries from the low-pressure side of the transformers; in running the street arc lamps in a series system on the same high-pressure mains which supply the transformers; in controlling the sub-station transformers from one central sub-station. The main generating station is located at a considerable distance from the area of supply; there are three sub-stations; the illustrations are of a technical character.

Hamburgh. *L'Ind. Elec.*, June 10.—A short article giving some of the accounts of this station, which was the first one in Europe to supply current for both lighting and traction, and is therefore of special interest.

Electricity in Mining. Eng. & Min. Jour., June 20.—A short editorial note stating that electricity is finding in mining and metallurgy one of its widest and probably its most profitable fields; for power purposes in mines it is now in most places the most advantageous, and in the shop is always the most convenient source of power; in metallurgy the field for electricity is equally extensive; at present nearly all the copper, and most of the gold and silver are refined electrolytically, while several other metals are reduced by its use; in the chemical industry electricity is rapidly supplanting the older methods and is certain to become more popular.

Total Efficiency of Certain Central Stations. Merrill. *Elec. Eng'ing*, June.—He discusses the question from the standpoint of actual practice and shows the difference between test and working results; he takes two stations and examines them from this standpoint, the object being to assist, with the aid of comparative statistics, designing stations that will give the best results; tables showing the operation are given, as also diagrams of the arrangement; the first contains two 90-kw alternators; the second is an ideal station, with four direct-current dynamos of 500 kilowatts each.

Use of Accumulators with the Alternating-Current Supply at Zurich. *Elec. Rev.*, June 24.—A reprint (without acknowledgement) of the abstract which was noticed in the *Digest*, June 13.

Distribution System. Gutmann. *Elec. Eng.*, June 24.—A communication stating that the system attributed to Ferraris and Arno (see *Digest*, June 6 and 13) is not new, but was described by him in his Institute paper in 1894.

WIRES, WIRING AND CONDUITS.

Cable Specifications and Tests. Jeckel. Lond. *Elec. Eng.*, June 12.—A brief abstract, with the discussion, of a Municipal Electrical Association paper. He said it would be fairer and better for both contractors and corporations if it was stated in the specifications exactly what cable was required; regarding the conductivity he thought it best to specify the resistance which the cable has to have, and the number of strands, leaving it to the manufacturer to put in copper of any conductivity that he wished; in concentric cables it should be distinctly specified that the outer one should have the same conductivity as the inner; high insulation was itself not a necessity; pressure tests are advisable in all cables, more especially in compounded ones; in the latter bending tests are also advisable; the insulation tests should be made after one month's electrification; the discussion contains little of importance technically.

Inherent Defects in Fuse Metals. Harrington. *Jour. Frank. Inst.*, June.—A reprint of a complete paper (see *Digest*, April 18). He strongly condemns the present methods and practice, and shows that fuse metals cannot be considered as the correct and safe way of protecting. He describes some tests to demonstrate these inherent defects; among these he showed that fuses carry 50 to 200 per cent. of current in excess of the rated fusing current; on short circuits fuses will carry excessively abnormal currents; fuse metals of alloys having a low melting point can be maintained at a red heat; such metals as copper, aluminum, iron, etc., are not adapted for fuse metals, owing to the high temperature of their fusing point; fuses will cause arcing, especially when enclosed; they are very sluggish in fusing. From this he concludes that fuse metals are not safe for protecting buildings and then describes the magnetic circuit-breaker which he claims should take the place of fuses; the device referred to has already been described; the salient features of such an apparatus are that it should have no springs, insulation must not enter into the construction of the trigger or catch, bearings liable to rust should be of phosphor bronze, and the plunger must not act on the retaining catch or switch arm, unless a free preliminary movement preceded such action.

ELECTRO-PHYSICS AND MAGNETISM.

Cathode Rays Under the Influence of Strong Magnetic Forces. Birkeland. Lond., *Elec. Rev.*, June 12.—The first part of an abstract of an article translated from a Norwegian journal, which is thought to be of considerable interest; the translation is not as clear as might be desired and there are errors in the references to the figures. He describes experiments which show that cathode rays are developed more easily along magnetic lines of force and can be produced only with difficulty in other directions; a tube with a Maltese cross in the centre forming one of the poles, was placed next to a powerful electromagnet whose axis was perpendicular to the cross; when the magnet was not energized, a phosphorescence was produced, but when a current passes through the magnet a strong luminous band radiates toward the magnet and at its intersection with the glass a lilac colored, nearly white image of the cross is produced, smaller than the original; with high voltages the image of the cross is intensely yellow; divergent rays are also projected from the other side of the cathode from the magnet, but they are weaker and the image cross is larger; both images are turned through a small angle in the same direction, namely, in the direction of the hands of a watch, when looking in the direction of the lines of force; when the bulb is turned the images are displaced, keeping their relative positions with the magnet. The magnetic forces are capable of neutralizing the property of a concave cathode, of converging the rays; if the concavity is turned away from the magnetic pole the rays will become almost parallel; another experiment shows how the rays can be converged to a point by a magnet "the axis of the magnet being perpendicular to the plane of the magnet and passing through its centre;" (it appears that the electromagnet was "straight," presumably meaning a bar magnet); they can be converged quite as effectively as rays of light through a lens; the rays can easily be brought to a needle point on the inner side of the bulb where the action will be very intense, and will split off particles of glass, boring a small hole in six to two seconds, depending on the thickness of the glass. When a cylindrical tube is placed between the two poles of a horseshoe magnet there is no convergence of the rays and he therefore believes that the convergence is due to the magnetic lines of force. When the distance between the tube and the straight magnet is slowly changed, a remarkable phenomena is observed; when moved toward the magnet the phosphorescent spot becomes gradually smaller until it is reduced to a point, but while it is disappearing a new spot smaller and fainter than the first is produced, which in turn is also reduced to a point, and this is followed by a third repetition. All that has been described takes place with the north pole as with the south; the results appear to show that a cathode ray emits divers groups of different rays, related to each other somewhat as the harmonics of a vibrating string; this he illustrates with further experiments, in which both the image of the cross and the phosphorescent spot are shown in different positions; the angle through which the image of the cross is turned does not appear to depend on the magnetic force, but on the distance between the cross and the glass; the twist or distortion from the north pole is in the opposite direction from that of the south pole; as many as five successive phosphorescent spots have been obtained; when the motion of the tube is toward the magnet the turning of the image is clockwise when looking along the lines of force; when the motion is in the positive direction the twist is also in the positive direction; "the intrusive lilac cross (meaning the image) may also be avoided by connecting up a Röntgen tube in series with the Crookes tube. With this arrangement the different cathode harmonics can be brought out with wonderful clearness and beauty." The abstract is to be continued.

Röntgen Rays. Lond. *Elec. Rev.*, June 12.—An article devoted chiefly to an abstract from the *Nuovo Cimento*, April, page 193, by Battelli, describing a series of exhaustive experiments to settle the question raised by the statement of De Metz, who said that cathode rays had a photographic action, which was objected to by Poincaré, who claimed that the impact on the cardboard covering immediately transformed the cathode into X-rays. Battelli concludes that cathode rays inside of the tube have a photographic action, even when the char-

acteristics of the rays have not been observed in the tube; this photographic action increases with the rarefaction; among the rays producing a photographic impression, some are deflected by a magnet and others are not; that therefore Röntgen rays exist inside of the tube; the Röntgen rays pass more readily through the walls of the tube; to say that Röntgen rays are produced in the tube together with cathode rays, does not contradict the experiments which show that Röntgen rays apparently originate from the point where a material object is struck by the cathode rays; that object may act either as a filter or as a diffuser. To demonstrate the photographic action he wrapped strips of sensitized films around brass tubes and covered them with black paper, over which was placed a wire pattern; it was placed in a tube between the anode and cathode; the results are given in a table, and show that there is a direct impression by the action of the cathode rays; little or no effect was produced from the side toward the tube; in another experiment one of these brass tubes was placed inside and another one outside of the tube, and the impression was always enormously greater on the one on the inside, showing that the fluorescence of the anti-cathode has a far weaker effect; similar experiments were made opposite the anode and other parts of the tube, the results being in favor of the hypothesis that cathode rays contain the Röntgen rays. In another experiment the brass tube with a film was enclosed in an exhausted tube fused on the end of a Crookes tube; at pressures higher than $\frac{1}{10}$ mm an impression was obtained on the internal film, but none on the external; at pressures between $\frac{1}{100}$ and $\frac{1}{200}$ mm both were blackened, but the internal more than the external one. Another experiment explained the different behavior of cathode and X-rays in the magnetic field; he shows that part of the cathode rays are not deflected by a magnet; when a film is placed in a tube, and the rays deflected, an impression is still obtained by some invisible part of the radiation from the cathode which has not been deflected, but the deflected rays also have a photographic action. He also made experiments to find out at what pressure the photographic action of the rays commences inside of the tube; at 0.3 mm this action exists and increases very rapidly down to 1-170 mm, after which it appears to remain constant; at 0.2 mm there was no action on a film outside of the tube even with a three-hour exposure. Editorially, these experiments are thought to be the greatest advance in the theory of X-rays since their discovery. The article refers also briefly to some experiments of PIKE; ordinarily it takes about four hours for exhausting a focus tube; this he has reduced to two hours by inserting two additional electrodes in the tube a short distance apart and sending a powerful current from a transformer across the gap between them, the electrodes being made of metals which absorb the gases; there is no further use of the pump after this current is started.

Röntgen Rays at Low Temperatures. BLEEKRODE. Lond. *Elec. Rev.*, June 12.—He describes experiments made with a focusing tube cooled by a mixture of solid dioxide of carbon and sulphuric ether. By cutting slabs of this solid, the temperature of which is —79 degrees C., he found that it transmits the rays to a certain extent; his results seem to indicate, in accordance with Prof. Dewar's researches of phosphorescence at very low temperatures, that this property of glass is also enhanced; the photochemical effect of the rays was equally great as at the ordinary temperature; an image of a finger showed equally well flesh and bone, and required the same time; with the electroscope also there was no evidence that the effect was lessened.

Röntgen-Ray Experiments. SWINTON. Lond. *Elec.*, June 12.—Referring to the statement of Lodge that the platinum disc is always charged positively, he states that he observed this also and noticed that except in the immediate vicinity of the cathode any connection to the interior of the tube is positively charged; Prof. Crookes noticed this as early as 1891; this shows why the position of the anode is of small importance as it is merely a connection of the rarefied gas. When focusing tubes become badly blackened they cease to be effective, which is generally attributed to an increase in the vacuum, an explanation which may be true in part, but another is the fact discovered by Crookes that the spark passes much easier the greater the phosphorescing power of the substance surrounding the poles.

Examining the Action of Röntgen-Ray Tubes. MANCE. Lond. *Elec. Rev.*, June 12.—It is sometimes difficult to determine when the desired degree of vacuum has been obtained and whether the radiation is of that form which distinguishes best between flesh and bone, as different tubes act differently in this respect; he describes a simple device for examining the action of the tube, which consists essentially of a fluorescent screen conveniently arranged with a sight tube and a reflecting mirror, enabling the character of the rays to be readily seen by placing the hand over the apparatus.

Electric and Magnetic Research at Low Temperatures. FLEMING. Lond. *Elec. Eng.*, June 12; the beginning of a reprint of a recent Royal Institution lecture.—He describes the recent results obtained in the researches made by him and Prof. Dewar; the form of coils used is described and illustrated; a very large number of pure metals and alloys were tested in the form of wire, and the method used is described and illustrated; the resistances were measured at five definite temperatures, the highest being about 200 degrees C. and the lowest 185 degrees C., the boiling point of liquid oxygen at atmospheric pressure. The most striking result was a very great reduction in the electrical resistance experienced by all pure metals when cold; the resistance of iron was reduced to about one tenth; when one iron coil is placed in boiling liquid air and the other in boiling water the resistances are as 1 to 12; the resistance of alloys, however, changes comparatively little; he describes how the temperature was measured by the resistance of platinum.

Resistance of Bismuth. Lond. *Elec.*, June 12.—In a reference to a recent lecture by Dr. Fleming on electric and magnetic research at low temperatures, it is stated that the resistance of pure chemically prepared bismuth shows a minimum point at 80 degrees, while electrically prepared bismuth behaves in a perfectly normal manner, its resistance line pointing toward absolute zero like that of other metals.

Mercury Arc. Lond. *Elec.*, June 12.—A brief notice of a paper by Arons from the *Wied. Ann.* He describes his apparatus for investigating the arc light produced between terminals of mercury, amalgams and alloys, in an inverted U-shaped tube in which the upper part is exhausted; arcs of two feet in length can be produced; the tube is surrounded by a water jacket to keep it cool; the lengthening of the arc by one cm requires an additional pressure of 0.67 volt.

Computations for Coil Winding. SLINGO and BROOKER. Lond. *Elec. Rev.*, June 12; a conclusion of their article (see *Digest*, last week).—They deduce a number of equations based on assumptions given in the previous portion.

Refraction of X-Rays. GOUY. *L'Ind. Elec.*, June 10; a reprint of an Academy paper.—He used a focusing tube containing a platinum plate, which was the source of the rays, and finds that the radiation is nearly equal in all directions inside of a hemisphere limited by the plane of the platinum disc; this law, which is contradictory to the cosine law in photometry, shows that the platinum disc is a source of rays of which the intrinsic intensity is approximately inversely proportional to its apparent size, and therefore at a point near the plane of the disc it would act as a source of great intensity; on this he based the construction of a tube in which the apparent width of the source was only 0.1 millimetre. He used this for finding the refraction in crown glass and aluminum; the distance was 4.5 metres, and the time of exposure 3 hours; a very sharp image of a thin platinum wire was produced; the results showed a deviation of 2 seconds, from which it follows that the index of refraction differs from unity by less than one two hundred thousandth; he also showed the total absence of refraction.

Properties of X-Rays Traversing Ponderable Media. MALTEZOS. *L'Ind. Elec.*, June 10; a brief abstract of an Academy note.—In applying the Helmholtz theory of rarefaction and the Maxwell electromagnetic theory of light, he comes to the following conclusions: If the X-rays are considered as hyper-ultraviolet rays, as is now likely, he thinks it possible to explain the fact of the different absorptive power of bodies in supposing that the refractive index is not exactly equal to unity, but that although very nearly this value for all bodies, it varies with the density.

Source of X-Rays. STCHERBAKOF. *L'Ind. Elec.*, June 10; an abstract of an Academy paper.—A piece of lead with a small hole was fastened on the outside of the tube over the fluorescing spark; some distance off was mounted a piece of metal not very transparent to the rays, and perforated with small holes; behind this was a sensitive plate; under these circumstances, from the results of an exposure, he calculated the distance to the surface of emission of the rays and finds this surface to be in the interior of the tube, at a certain distance from the interior surface.

Photometry of Phosphorescent Sulphide of Zinc Under the Action of Cathode Rays. HENRY and SEGUY. *L'Ind. Elec.*, June 10; a reprint of an Academy paper, giving the results of photometric measurements.—The description is not quite clear; among other things they show that the brightness diminishes rapidly with the time, which loss they attributed to the formation of small black points in the material; the brightness increases and decreases according to exponential functions of the pressure.

Röntgen-Ray Tubes. KOENIG. *L'Ind. Elec.*, June 10.—A French abstract of the article from the German, noticed in the *Digest*, June 13.

Observations with X-Rays. ARGYROPOULOS. *L'Ind. Elec.*, June 10; an abstract of an Academy paper.—In experiments with different fluorescent substances, he found that platino-cyanide of potassium and sodium, as also platino-cyanide of potassium and lithium, are much more luminous than the corresponding salt of barium; the fluorescence of these is easily visible at a distance of five metres while with the barium salt the distance is only quite small.

Electric Images in the Field of a Hittorf Tube. OUMOFF and SAMOILOFF. *L'Ind. Elec.*, June 10; an abstract of a Physical Society paper.—In place of the fluorescent screen in the Röntgen experiments a plate of ebonite may be used and the image on it developed by dusting it with a mixture of sulphur and minium; if an object is interposed between the tube and this screen an intense red spot will be produced corresponding to the fluorescent spot of the tube.

New Radiations from Metallic Uranium. BECQUEREL. *L'Ind. Elec.*, June 10; a reprint of an Academy note.—Some months ago he showed that uranium salts emitted radiations which were heretofore unknown, and which had remarkable properties, some of which are comparable to those of Röntgen rays; these rays are emitted not only after the materials have been exposed to the light, but also when they were in the

dark for several months, without apparent diminution; the rays affect sensitive plates like Röntgen rays; exposing the substances to light, the radiation is increased, but after a few hours it falls again; these rays are refracted and reflected like light; they discharge electrified bodies and traverse opaque bodies; the absorption is less in passing through bodies than with Röntgen rays; with uranium itself or its carbide, the radiations are much more intense than from the salts; some figures are given showing the relative strengths of the radiations from the uranium and its salts; he thinks this is the first case noticed of a metal showing a phenomenon on the order of an invisible phosphorescence.

Magnetization of Alloys of Iron and Antimony. Weiss. *L'Ind. Elec.*, June 10.—An abstract of a Physical Society paper giving the results of experiments with 10 alloys, the magnetic properties of which are intermediate between feebly magnetic and strongly magnetic bodies.

The Part Taken by Iron in Dynamos. Potier. *L'Ind. Elec.*, June 10.—An Academy note replying to and criticising unfavorably the recent new theories advanced by Deprez. The same journal contains a reply to this by Deprez and promises to publish another reply by Potier.

Mechanical Conceptions of Electrical Phenomena. Dolbear. *Jour. Frank. Inst.*, June.—The first part of a reprint in full of a recent lecture; the lecture, which is somewhat long, should be read in its entirety to be fully understood. He endeavors to dispose of the idea of forces of all sorts, as quite intangible in a mechanical sense; he points out the factors of energy, namely, matter, ether and motion, of which three motion was the only variable, the only one to be considered in a qualitative sense; he points out that in mechanical energy and in heat and light phenomena, such distinctions are made, but they are often confounded in our terminology. Regarding electrical phenomena proper, he shows what the antecedents are in each case, namely, forms of motion; then, what its effects are, namely, forms of motion in matter or ether, only we profess to be mystified at the intermediate step called electrical, and say that we do not know what it is; the author contends that we do know and that there is but one answer, unless one assumes new factors of energy which are unnecessary; when energy of any kind has been transformed, it is no longer proper to call it by the same name; in heat and light we do not know, but in electrical phenomena we do, when we talk of electric waves; these are no more electric than are light and heat waves; such terms refer to the antecedents of the waves but tell nothing about their quality otherwise; he concludes that electrical phenomena are atomic and molecular, the probability being that they are rotations in the same sense in which heat phenomena are vibrations of ordinary matter. He emphasizes that the action in ether is not electrical action but more properly the result of electromagnetic action; electric, like magnetic, action begins and ends in matter and is subject to transformations into thermal or mechanical actions or into ether stress. He approves of Lodge's warning that perhaps after all there is no such thing as electricity; electrification and electric energy may be terms to be kept, but if electricity as a term be held to imply a force, fluid, or thing "which would be described by some one who knew enough, then it has no degree of probability, for spinning atomic magnets seem capable of developing all the electrical phenomena we meet."

Increasing the Striking Distance of a Given E. M. F. E. Thomson. *Elec. Eng.*, June 24.—Referring to the phenomenon described by Skinner (see *Digest*, June 20), he states that this is by no means new, as he (Thomson) had known and used it for at least 30 years; he used a rod in a test tube, and increased a half-inch spark to three inches. Another fact showing the experiment to be very old is that in the old friction-plate machines there was often a glass ball on the prime conductor, silvered on the inside, which was intended to increase the capacity; sparks could be taken from the ball itself, and would travel many inches over the glass surface from the neck of the ball to the discharging body. Another method which he used was to smoke a piece of glass and cause the discharge to pass over the smoked surface, greatly lengthening the spark gap; the spark left a clear tracing which could afterward be examined with a magnifying glass.

Dry Plates for Radiography. Ward. *Sc. Amer.*, June 27.—A brief report of a paper read at a meeting of the Royal Photographic Society. Plates fairly sensitive to light are needed for radiography; with a suitable film an increase of thickness has a decided advantage, and the amount of silver present is an important factor; certain experiments seem to show that the speed would be increased in direct proportion to the thickness of the coating; soaking the plates in a solution of fluoresced salts tends rather to a loss of sensitiveness than to increase the speed; celluloid apparently has no advantage over glass as a supporter for the film.

Phosphorescence and X-Rays in Geissler and Crookes Tubes. Campanile and Stromei. *Elec. Eng.*, June 24.—A reprint of the article abstracted in the *Digest* last week.

Electrical Trevelyan Record. Vaughton. *Elec. Eng.*, June 24.—A reprint of the article abstracted in the *Digest*, June 20.

ELECTRO-CHEMISTRY AND BATTERIES.

Electrolytic Dissolution and Deposition of Carbon. Lond. *Elec.*, June 12.—An editorial discussion of the criticism by Vogel (see *Digest*, May 16), of the article of Coehn (see *Digest*, April 11), and also of the reply of the latter (see *Digest*, June 13). The general conclusions are that Coehn has made observations which are certainly remarkable and appear to be novel; Vogel has rightly insisted that some of the evidence adduced is not inexpugnable; failing counter-experiment by Vogel the results of Coehn may be accepted, but he should be required to make further investigation filling up the gaps indicated by his critic, before the conclusions which he comes to can be accepted as reliable data.

Accumulators of the Future. Warren. *Chem. News*, page 191, noticed in the *Zeit. f. Electrochem.*, June 5.—He applies this name to an accumulator which he invented in which the active materials are made of spongy-lead plates which are formed electrolytically and then saturated with dilute phosphoric acid, which is said to protect them from being sulphated. Editorially it is stated that a new method, which will soon be described, has just been invented to put into a good condition again plates that have been sulphated.

Preparation and Properties of Uranium. Moissan. *L'Ind. Elec.*, June 10.—An abstract of an Academy note describing the preparation of metallic uranium in the electric furnace and by electrolysis; he states that it can be obtained very easily by either method but best by reduction of the oxide in the electric furnace; the pure metal has properties much like iron except that it is non-magnetic.

Carbon Ions. The *Zeit. f. Electrochem.*, June 5, contains a short communication by Vogel in reply to Coehn's recent answer to his criticism; he states that Coehn attributed to Vogel things which he did not say at all and omits things which he did say; he will postpone further discussion until the complete paper has been published.

Electro-Chemical Institute. Nernst. *Zeit. f. Electrochem.*, June 3.—A long, illustrated description of the Institute at the University at Göttingen, for electro-chemistry and chemical physics.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Localization of Faults in Electric Light Mains. Raphael. Lond. *Elec.* June 12; a continuation of his serial (see *Digest*, last week).—He discusses the insulation testing of high pressure mains during the working; the testing of these is not as useful as for the low-pressure network as a fault will quickly burn itself into a dead earth; many concentric systems however, are exceptions; it is worth while to make a daily test of the mains. The first method described (which is No. 5), refers to continuous-current, high-pressure networks which are not permanently earthed; for this the first method described in his paper may be conveniently used; this he describes in detail; it is sometimes objected to because by earthing one main, an undue strain is put on the other; the only alternative is to use electrostatic voltmeters; he describes and illustrates the Hartman and Braun leakage indicator. In the case of alternating-current high-pressure mains which are not earthed, the potential of the mains should first be measured when they are known to be in good condition and the test should be repeated daily, the readings remaining the same from day to day; the actual potential of each of the two mains is not proportional to their relative fault resistances, as with continuous currents, but depends also to a great extent on the capacities; if the potential of one is always nearly zero, it does not follow that this insulation has broken down; the outer conductor of a well-insulated concentric system usually has a zero potential; but if one day it is much nearer zero than on the preceding, while the potential of the other has risen, then a fault has developed on the former. There are three ways in which the potential of each main can be measured; the first (No. 6) is by means of an electrostatic voltmeter, which may always be left connected; another (No. 7) is by means of a vacuum tube, one end of which is held by the hand or otherwise connected to the earth, and the other end is placed against the main; this can be used very well for a side-by-side system, but not always with a concentric system; in the latter the normal potential of the outer main is very much less; another method (No. 8) is to use an electromagnet or hot-wire volt meter in series with a high resistance; one of the mains may be earthed through a high resistance and the other through the voltmeter, the voltmeter and the resistance being then made to change places; the resistance need not be the same for both mains; this he thinks is the best system for concentric mains, but it puts an undue strain on the main which is not earthed; the Cardew, Drake & Gorham leakage indicator is described and illustrated. He then discusses general methods of fault localizing which are applicable to electric light networks; the loop methods are described, illustrated and discussed.

Apparatus for the Magnetic Testing of Iron. Ayrton and Mather. Lond. *Elec.*, June 12.—A brief editorial mention of an apparatus recently exhibited at the Royal Society, and which has been in use for some time in the laboratory of the Central Institution; it was mentioned by Prof. Ayrton in the discussion of Ewing's recent paper. The test bar or bundle of sheets is made the yoke of the field magnets of a small two-pole dynamo; coils are placed on this test piece, the binding being so adjusted that 10 times the magnetizing current gives the value of $\mathcal{H}$, the current being measured; the armature is run at a steady speed and the E. M. F. is measured, which when multiplied by 10,000 gives the value of the induction in the test piece; a rheostat in the exciting circuit enables a succession of conditions to be produced; the fact that all the magnitudes

are read as steady deflections makes the method very handy and convenient; no further information is given.

Three Voltmeter Method of Measuring Power. SCATTERGOOD. Lond. *Elec. Rev.*, June 12.—A short and simple geometrical proof of this method of measuring the power in alternating-current circuits.

Measuring the Insulation Resistance. PICOU. *L'Ind. Elec.*, June 10.—Abstract of a paper read before the International Society. This method can be used with small samples; it consists in placing in the circuit of the resistance a condenser and a battery; the condenser is allowed to be charged during a certain time and is then discharged through a ballistic galvanometer; from the data obtained, the resistance is easily calculated; a charge of 10 minutes suffices for resistance of millions of megohms; surface leakage is prevented by the well-known guard-reading system.

Electrochemical Actinometry. MARECHAL. *Zeit. f. Electrochem.*, June 5.—An abstract in German of the French paper noticed in the *Digest*, April 25.

Practical Testing of Iron and Steel for Magnetic Qualities. HOWE. *Elec. Eng.*, June 24.—A reprint with illustrations of a paper read before the Chicago Electric Association. Testing, although not essential, undoubtedly leads to economy; the benefits, which he describes, from making the tests are sufficient to convince one of the decided advantages. He discusses the proper selection of the samples, which is not an easy matter, requiring care and experience, as there are so many conditions which affect the permeability; as the iron is different in different parts of the casting it is best to get, say three bars from the upper, lower and middle parts respectively; in a cupola test samples should be taken off at different stages, all being cast in the same position and cooled equally; sheet-iron samples should not all be taken from the same sheet. He then describes and illustrates the various well-known methods of making the tests, including illustrated descriptions of the Ewing instruments, the Eickemeyer differential magnetometer, the instrument of S. P. Thompson and Kapp, and the one of Robinson.

Measurement of Power of Tri-Phase Currents. BEHN-ESCHENBURG. *Elec. Eng.*, June 24; a brief description of the method with the diagram, abstracted in the *Digest*, April 11 (see also May 2).

MISCELLANEOUS.

Municipal Electrical Association Meeting. Lond. *Elec. Eng.*, June 12.—A report of some length of the first meeting of this association, giving abstracts of the papers; some of them are very brief, with the discussions. Some of these papers are noticed in their proper places above; the others are the following: A presidential address of WRIGHT, which is general in character, showing the pressing want of some such association as the present one; this is given in full. A paper on "Electricity Supply at 220 Volts," by BARNARD, a very brief abstract of which is given; he points out the advantages and disadvantages, chiefly the former, of such a system. A paper on "Alternating-Current Stations and High-Voltage Lamps," by COUZENS, in which he shows some cases in which high-voltage lamps would prove of service to alternating-current stations; the paper is merely noticed, but the discussion is given rather fully; in this Jackson thought too much attention was paid to the saving in the mains for high-voltage lamps, and that the efficiency of the lamps was much more important; high-voltage lamps are not so economical, and he doubts if low candle-power lamps could be made; Worthingham gave a warning against the acceptance of the statement that ordinary fittings could be used for 200 volts; STEARN (of the Zurich Lamp Company) believed the opposition to the high-voltage lamps would die away; by a careful selection he thinks the fittings would be safe; the efficiency of an incandescent lamp does not increase as the voltage decreases; the average lamp now used requires 3.7 to 4 watts per candle, whereas 230-volt lamps requiring only .5 watts per candle could be easily obtained; GIBBINGS said he used high-voltage lamps successfully at Bradford aad found 3.7 to 3.8 watts per candle to be the maximum required; he thinks the question is not a ripe one for the present; at this station 380 customers were supplied at 230 volts during the past six months without complaint. A paper on "Municipal Control Wiring," by WORTHINGHAM, is briefly abstracted and is followed by the discussion; it is chiefly of local interest. A paper on "Electricity Works Records," by MOUNTAIN, is briefly abstracted; he gives an idea of the chief records required. A paper on the "Organization of an Electricity Works Staff," by MURRAY, is briefly abstracted and is followed by the discussion.

Australia as a Field for Electric Supply. DAWSON. Lond. *Elec.*, June 12.—A short article discussing the local conditions.

Exhibition. L'Ind. Elec., June 10.—An announcement that from the 15th of June to the 15th of October an exhibition will be held in Paris, devoted to "Lights, Chemical Industries and Self-Propelled Vehicles."

Electric Grass Killer. WALLACE. *Elec. Rev.*, June 24.—A reprint from the *Railroad Gazette* of a recent letter describing the apparatus of Sharp; it seems to contain nothing more than the article abstracted in the *Digest* a year or two ago.

New Books.

THE DYNAMO; HOW MADE AND HOW USED. By S. R. Bottome, Ninth Edition, 113 pp., 77 illustrations. London: Swan, Sonnenschein & Co., Ltd. Price, $ .90.

This little work was first brought out in 1887, and it met with such favor among amateurs—for whom it was designed—that it has run through eight editions, the present one being the ninth. The subject matter is not intended for those who make a business of manufacturing large dynamos, but primarily for amateurs and others who desire a small machine, capable of being worked by hand, and of giving a current sufficiently powerful for experimental purposes. The machines described are based on their construction on scientific principles, and are correctly proportioned.

The subject is introduced by a discussion of the underlying principles of dynamo construction, and then the practical part of the work is handled very explicitly. Dimensional diagrams greatly aid the amateur in his work, and by this means seemingly difficult tasks are rendered easy.

The subjects of the addenda relate to the different methods of winding, and failures in dynamos and their causes. Some useful tables pertaining to the relative proportions of the different parts of the dynamo machine are also given.

The work is written by an English author for English amateurs, but that does not in the least impair its value to Americans. It is evident that the author placed greater importance on clearness in executing the illustrations than on artistic finish. They have the merit of being very clear, notwithstanding their crudity.

ELECTRIC WIRING SPECIFICATIONS FOR INCANDESCENT LIGHTING. By George H. Kimber. New York: C. H. Irwin & Co., 1896. Sixty pages. Price, $1.25.

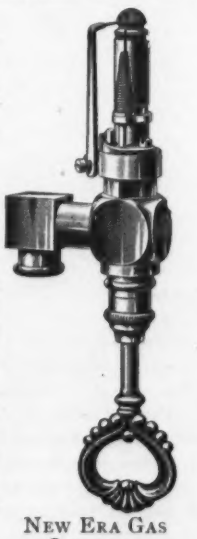
This little volume makes such extraordinary claims in its preface that one is tempted to throw it aside without reading further. For instance, the statements that "this is an age of specialists, and none can equip themselves with completeness in more than one branch of profession or trade without a corresponding weakness in each, respectively. This book is a great labor-saver in this respect." "In very large buildings where the assistance of an electrical expert will undoubtedly be required it will be found that this volume will considerably lighten both his and the architect's labors, presenting itself to their notice as a guide in travels through the mazes and complexities of modern wiring specifications." Passing by the paradox that in order to be complete one must be incomplete, we come to the next proposition. It is not very evident to a mind constituted in the ordinary manner how a volume of 60 small pages can render unnecessary an educational course, which the author himself says is so difficult that it cannot be mastered without neglecting something else. We are somewhat relieved to see that the author does not expect that the electrical expert will altogether pass into innocuous desuetude, but will still be necessary in very large buildings. The book has merit, although nearly one half of the space is occupied by a reprint of the rules of the National Board of Fire Underwriters.

The "New Era" Gas Lighter.

The plain "New Era" burner of the American Electric Company, Boston, Mass., which is illustrated herewith, combines some ingenious mechanism, yet is simple in construction.

It is operated only by the key which is securely attached to the valve, the latter extending up through the body and terminating in the pillar containing the lava tip. The spring electrode is rigidly secured to the pillar and turns with it when the key is operated.

A pin enters this spring electrode and projects a little below it, resting upon and sliding over the surface of a cam. This cam is so constructed that as the key is turned from left to right the pin is gradually elevated by the cam and lifts the point of the spring electrode until it is brought in contact with the point on the fixed electrode; it then falls off from this high position, the contact is broken, the spark is made, and the gas is let on and lighted.



NEW ERA GAS LIGHTER.

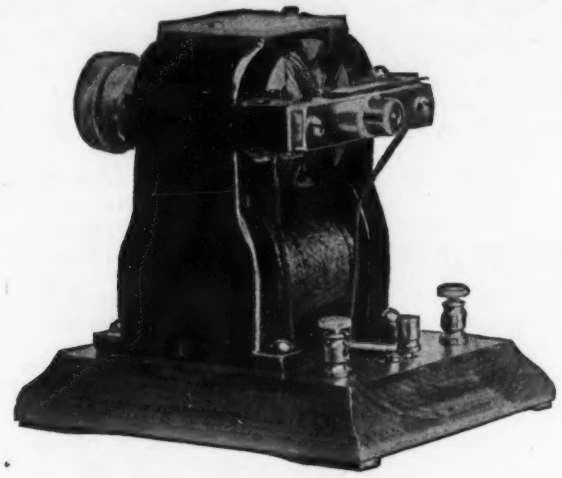
In turning the key to the left to extinguish the gas the pin slides on a lower plane on the cam, which permits the spring electrode to pass under the fixed electrode without contact, after which it reaches an incline which eventually restores it to its former position.

These burners do not leak and do not easily get out of order. They are reliable in operation, and it is claimed require less than half the usual mount of battery.

Dynamo for Rontgen-Ray Apparatus.

The Kent Electric Manufacturing Company, Worcester, Mass., in order to supply the demand for small alternating-current dynamos for the operation of induction coils, has remodeled its standard direct-current dynamo for the purpose, and states that the remodeled machine gives successful results.

The company makes a water motor which is capable of running the



RÖNTGEN-RAY DYNAMO.

alternating-current machine, the combination of the two making a very compact and convenient outfit. The dynamo, however, may be operated by any other power.

This apparatus, the company claims, will give a suitable current for Röntgen-ray experiments, and will be found very useful and convenient by experimenters who have not the use of regular alternating current.

New Railway Signal.

On Thursday last a party of railway men went to Kingsland, N. J., on a special train to witness the operation of the Bezer "Motion" railway signal, with which a section of the Delaware, Lackawanna & Western Railroad is equipped.

The principal feature of this signal is the revolving semaphore arm or blade. When the section of the track ahead is clear the semaphore arm revolves, but when it is not clear the arm remains stationary, taking the position of a right angle to the post, as is the case with the signals now in general use. This position in railway parlance is the "danger" signal, and in this new system it is not changed.

The revolving arm, which gives the impression of a wind wheel when first seen, conveys to the engineer the idea of motion, indicating to him that he may keep in motion, but when he sees it stationary he thus reads the injunction to stop. This feature of the signal is looked upon by railway men as a very important one, and is regarded with considerable favor.

The operation of the new signal will be readily understood by reference to the accompanying illustrations.

Figs. 2 and 3 show respectively the semaphore arm at the danger position and in motion. The mechanism which operates the arm is contained in a small box set on an iron bracket attached to the pole, as shown in Fig. 2. The box contains a small Lundell motor (*M*, Fig. 1), to the armature of which is geared the semaphore shaft, the operation of the motor being controlled by the opening and closing of the track circuit, which method will be presently explained.

The conditions represented in Fig. 1 are those existing when a train enters a block. The wheels close the track circuit through the metal fingers *bb* by way of the metal strip *C*, on the insulating sleeve on the semaphore shaft and the solenoid *S*. Normally, when the track circuit is open, the pin *P*, which is an extension of the solenoid core, engages a hole in the larger gear wheel and locks the semaphore in a horizontal position.

The moment the track circuit is closed the core of the solenoid is withdrawn and with it the pin *P* from the hole in the gear wheel. At the same time the motor circuit is closed at *E* by the pressure of the solenoid core against the spring lever at the left, and the motor immediately starts up. The moving armature being geared to the semaphore shaft causes the latter to revolve, and with it the brass strip, *C*. As the shaft revolves, the connecting strip *C* is removed from under the fingers *b b*, thus breaking the track circuit at that point, but the solenoid core keeps the motor circuit closed because the pin *P* now presses against the face of the gear wheel, thus keeping the contact points *E* closed. When, however, the hole again comes into line with the pin—which it does, of course, once every revolution—the tendency is for the pin to be forced into it and break the motor circuit. This will or will not occur according to whether the train has passed off or is still on the block. If it is still on, this is what happens: When the connecting strip *C* passes under the two fingers, the track circuit is closed just at the moment the pin would drop back into the hole were it not held back by the action of the solenoid which is energized at this particular instant; thus the shaft and semaphore continue to revolve. If the train has passed off the block, the pin slips back into the hole in the gear wheel, because the track circuit, now being open on the track itself, cannot be closed at *C*, and the solenoid is inactive. When this happens the motor circuit is of course broken at *E* and the motor stops, and at the same moment the pin slips into the hole in the gear wheel and locks the semaphore arm in a horizontal (danger) position.

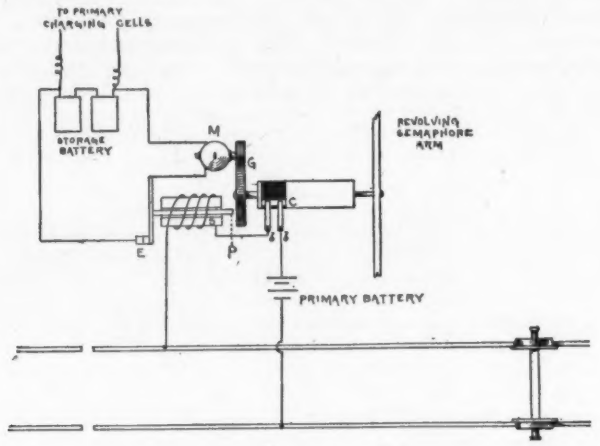


FIG. 1.

For night signaling a lamp is placed on the spindle passing through the top of the box which contains the motor (see Fig. 2). This spindle revolves vertically when the motor is in operation, and the lamp, which has four bull's eyes—two white and two red—flashes red and white signals alternately. If the signal is set at danger, the spindle remains stationary and the red light shows uninterruptedly.

A storage battery to operate the motor is placed in an earth box at the side of the track. It consists of two cells of chloride accumulators, which are being continually charged by seven Gordon-Burnham cells placed in a box at the base of the signal post. The Lundell motor is wound for four volts, taking 2½ amperes.

Only two cells of Gordon-Burnham battery are used for the track cir-

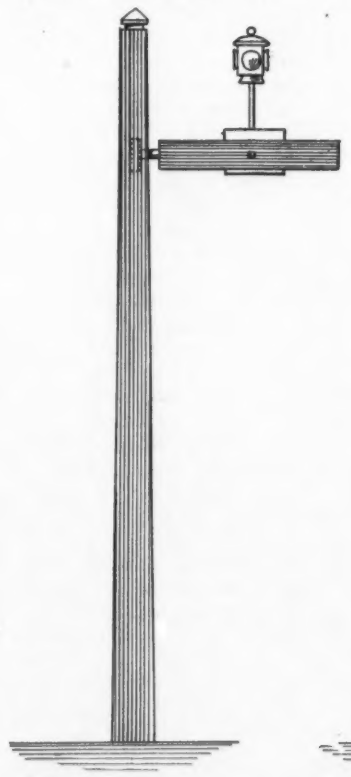


FIG. 2.—DANGER.

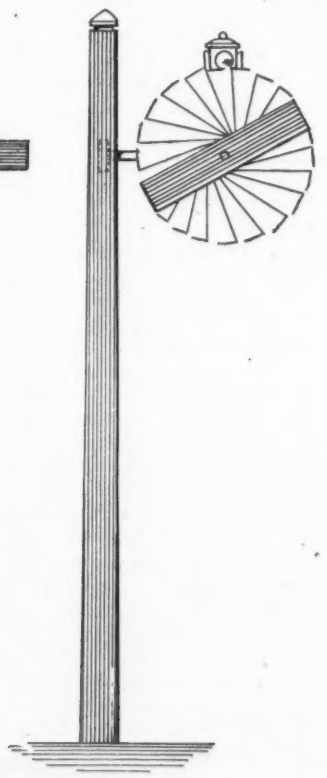


FIG. 3.—CLEAR.

cuit. This circuit is closed only a small fraction of a second during each revolution of the semaphore, thus a great saving in battery power is effected.

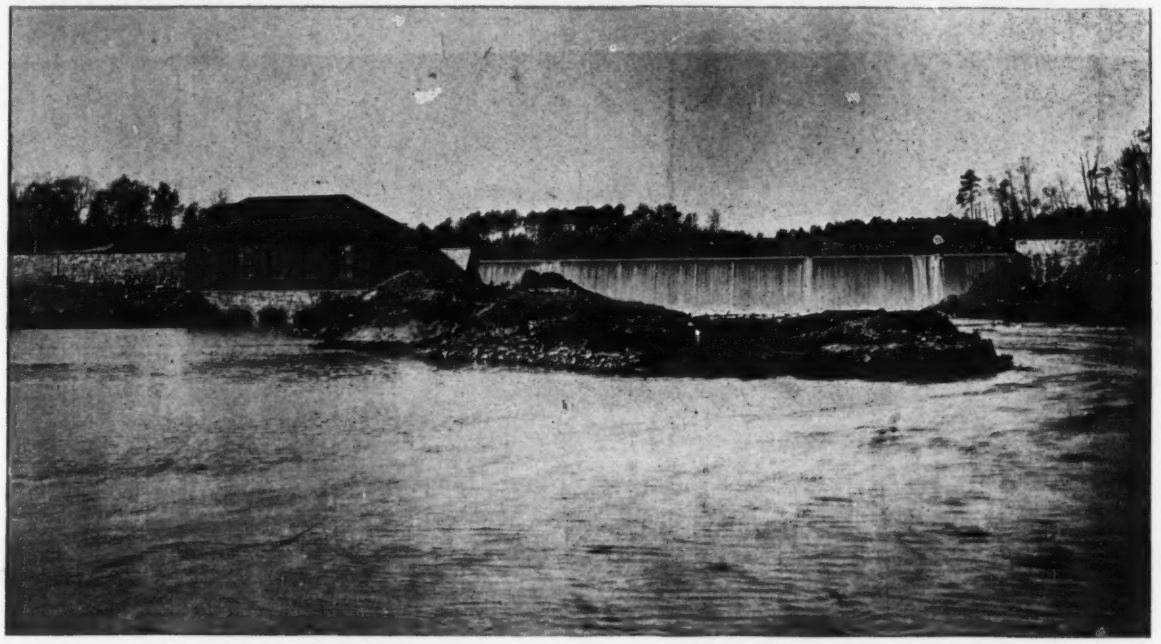
The semaphore arm revolves about 10 times a minute and the lamp flashes 20 times—10 white and 10 red flashes.

In this system only one wire is required for its operation, the rails being used as the return.

It may be stated that when the section ahead is blocked the rear semaphore is prevented from revolving through the operation of the track relay, which is common to all automatic electric signal systems.

The Pelzer (S. C.) Long-Distance Plant.

The accompanying illustrations show the power-plant recently installed for the Pelzer Mfg. Company, Pelzer, S. C., one representing the dam and power house, the other an interior view showing five pairs of 39-inch horizontal Victor turbines in position, each pair of which is coupled direct to a 1000-hp generator, and regulated by a Giesler electro-mechanical governor. The power thus generated is transmitted electrically to the cotton mills of the corporation, about 3½ miles distant. This is



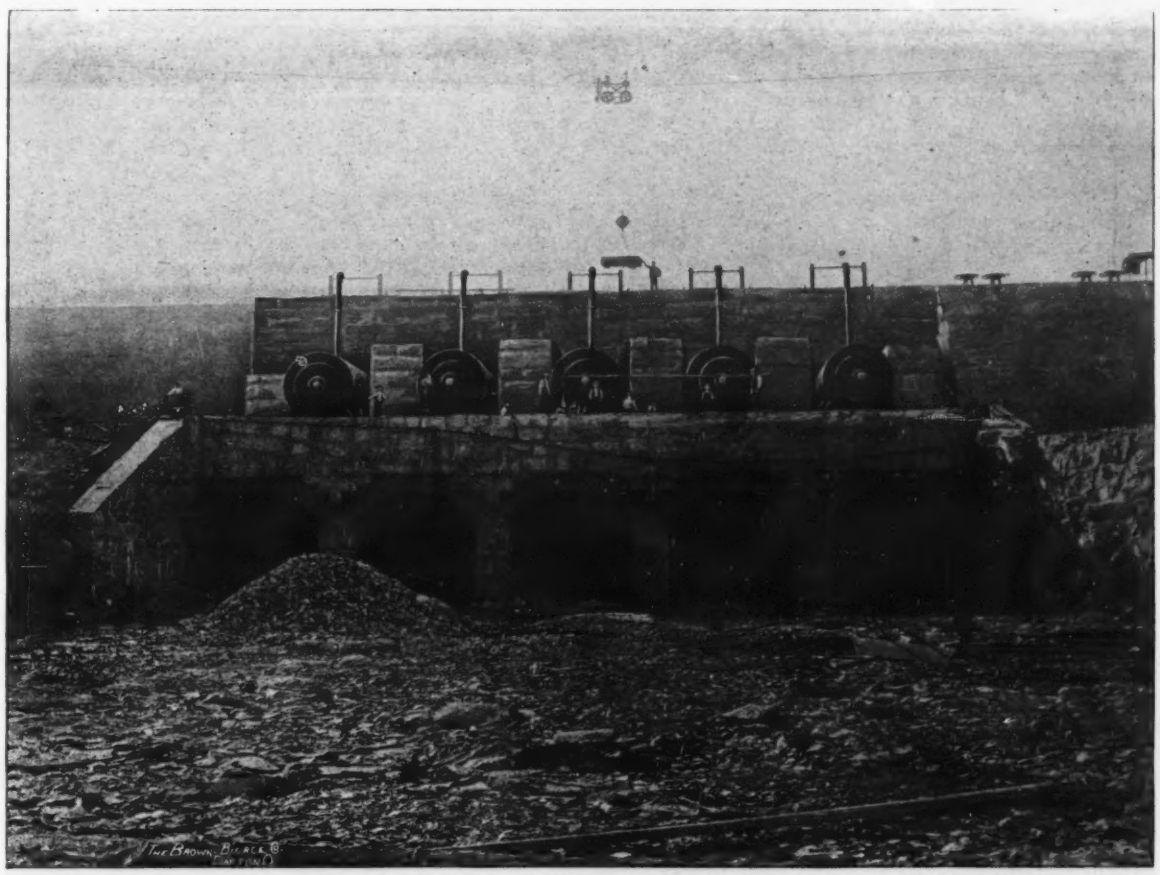
DAM AND POWER HOUSE, PELZER POWER PLANT.

putting 5000 horse-power into a very narrow space, and the arrangement permits locating the factories at a most eligible site. The dam and power-house were built by W. A. Chapman & Co., Providence, R. I., The electrical machinery was furnished by the General Electric Company of Schenectady, and the turbines, feeders, power connections and electro-mechanical governors, together with all the plans for the entire development, were furnished by the Stilwell-Bierce & Smith-Vaile Co., Dayton, O.

The Nantasket Beach Railway.

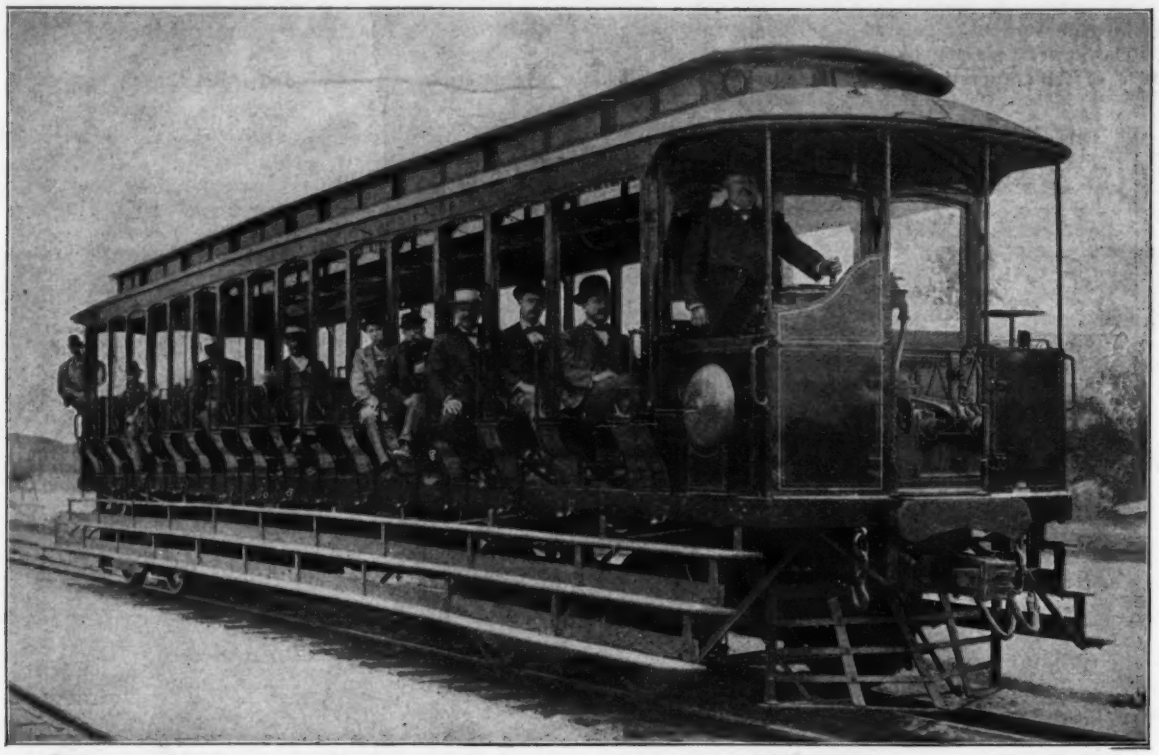
The second step toward the operation of its main lines by electricity was made June 26 by the New York, New Haven & Hartford Railroad Company, in the extension of the electrical equipment of the Nantasket Beach line as far as East Weymouth, 3½ miles along the main line of the South Shore branch of the Plymouth Division, of which J. C. Sanborn is superintendent.

In determining upon this extension the overhead trolley system in use on the Nantasket Beach branch was abandoned and the third-rail method of contact adopted as the most readily adaptable to ordinary railway requirements. This is the first time in the history of railways that the main line of a surface steam railway has been operated by electricity taken from a conductor laid upon the ground, as the Nantasket Beach inaugurated just 12 months ago was the first steam road in the world to which electricity was solely employed as the motive power.



TURBINES OF PELZER POWER PLANT.

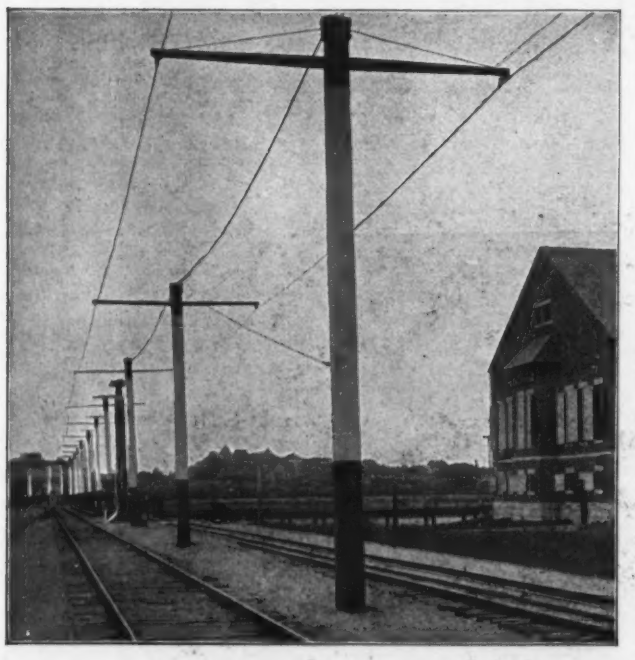
While the third-rail system for electric roads is not new, it being in use on the West Side and Lake Street Elevated Railways, in Chicago, the rail being set outside the track, this is the first instance of a third rail being laid upon the permanent way of a trunk steam road, between the rails of the service track. The preliminary work was carried out at the Schenectady works of the General Electric Company.



Motor Car, Nantasket Beach Railway.

The current for the third-rail section is brought from Power House No. 1, on the Nantasket line, over two insulated feeders of copper cable, laid along the tops of the poles which carry the overhead wires of the Nantasket line. At the Nantasket Junction station the feeders are dropped to the ground and each is connected to its own third rail.

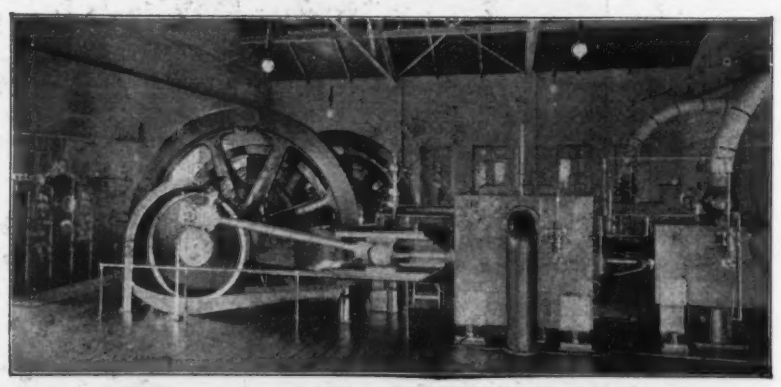
The third rail is of peculiar shape—the end view resembling a flattened A. It is laid midway between the two service rails of each track. Each section of third rail is 30 feet long, and weighs 93 pounds to the yard. It is supported by three ash blocks to each section, the blocks being let into the ties. Before use these blocks are boiled in vacuum pans with a tar compound, and thus each pore is filled with insulating and preservative material. The insulation is almost perfect. The continuity of the third-rail circuit is secured by attaching each end of one rail to that of the next by means of two heavy copper bonds. The line between Nantasket Junction and East Weymouth is absolutely distinct electrically from that between the first-named stations and Pemberton. It is fed by its own feeders and is provided with its own automatic safety appliances which, in case of carelessness or accident to the third-rail section enter into action and cut all electricity off from it, rendering it nothing more than a peculiarly laid stretch of track.



Trolley Line and Third Rail.

The electricity is taken from the third rail by two sliding shoes hung loosely from the car, one suspended between the axles of each truck immediately under the king pin by two links which allow it to slide easily over the top of the third rail and make perfect contact with it all the time. The current is brought to the motors through the controllers and circuit-breakers, and returns to the track rails by the wheels. The continuity of the return circuit is secured by using a short, thick bond of copper cable to join together the ends of each pair of track rails, the ends of the bond being fastened into the flange of the rail. The distance between each of the two shoes on the car is 33 feet. No third rail is laid at the crossings, the circuit continuing between the broken end by means of lead-covered cables. At the crossings, less than 30 feet wide, one of the shoes is always in contact, at wider ones the impetus of the moving car brings the shoes into contact again before the car can come to rest.

The baggage cars in use last year, each equipped with four motors, have been abandoned, and the large 16-bench open cars are alone employed as motor cars or locomotives. Sixteen of these cars will be put into service each equipped with two G. E.-2000 motors, two series-parallel controllers, two automatic circuit-breakers, the safeguards from accidents to the rest of the electrical apparatus and an air pump and motor for the compressed air for the whistle and brakes. The air-pump combination is automatic in its action. As soon as the pressure in the main air tank falls below 90 pounds to the square inch a small knife switch is closed by a spring and the motor starts. The switch is forced open by the air pressure as soon as that in the tank reaches the normal.



Interior of Power House No. 1, N. Y., N. H. & H. R. R.

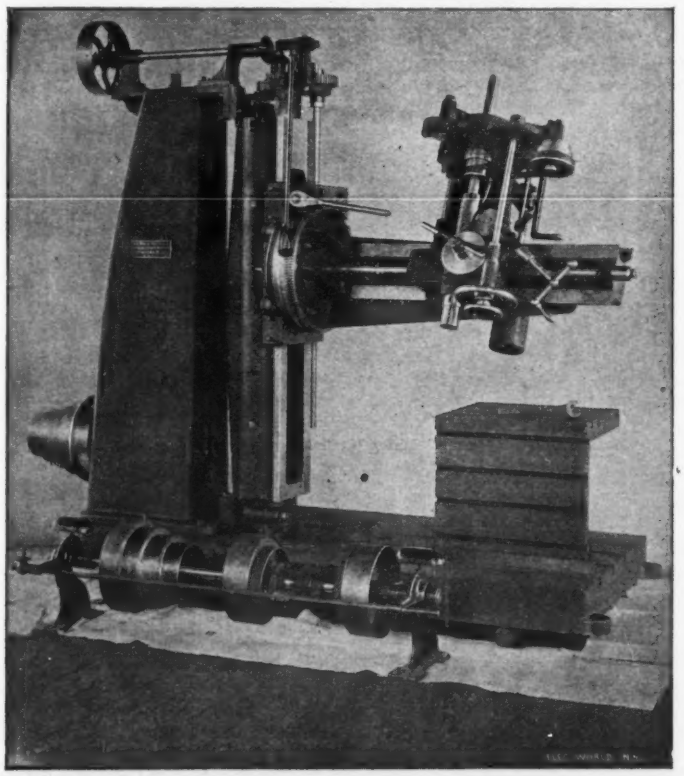
The cars leave Pemberton and run with the trolleys as far as Nantasket

junction. The trolley is then pulled down and hooked and the shoe strikes the third rail, the passengers being unaware of the change in the method of contact. The regular schedule of the electric trains between Pemberton and East Weymouth has been in force since June 14, but owing to the incompletion of the third-rail section the trains have been hauled from Nantasket Junction to East Weymouth 3½ miles by two steam locomotives. A good idea of the advantage of electricity as a motive power compared with steam may be gathered from the fact that the two locomotives burn each four tons of coal per day, while not more than four tons per day burned in the power-house serves to generate sufficient power to operate the whole seven miles of line between Pemberton and Nantasket Junction by electricity.

The construction of the new section has been carried out under the personal supervision of Col. N. H. Heft.

Universal Radial Drill.

The Wm. H. Warren Machine Tool Works, Worcester, Mass., has been prominent in the manufacture of drilling machines since 1876, and is well known to the electrical and manufacturing interests. We illustrate herewith one of its newest types of improved 4½ feet universal radial drills, the mechanical details of which are as follows: The upright column rests on nineteen ⅞ inch steel balls, the extreme distance from the column to the centre of the spindle being 52 inches. The arm has a vertical adjustment of 41 inches, and is raised and lowered by power. The spindle has a 15-inch travers with quick return and counterbalance fitted for a No. 4 Morse taper. The arm has worm gear and will cut an entire circle. The back gears on the head are so arranged that a change from open belt to back gears and changes of drills, etc., are quickly accomplished. They increase power 4½ times. The cone has four changes. The base table



IMPROVED RADIAL DRILL.

is 7¼ inches deep, finished, 47 inches wide and 8½ feet long, and has four slots cut from solid stock. The approximate shipping weight of this machine is 10,500 pounds.

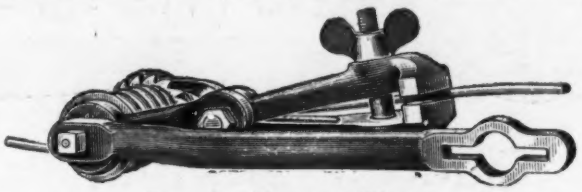
The company also manufactures a drill of smaller size and three of larger size.

Patent Combined Vise and Winch.

Brown, Jaeger & Co., 919 Betz Building, Philadelphia, Pa., are the sole manufacturers of the Doherty combined vise and winch, which is shown in the accompanying cut. This tool is used at present in telegraph, telephone, trolley wiring, electric-light line work, in tightening guy wires, in putting up suspension wires for aerial cables, pulling up wires and in cutting out slack. In fact it can be used for stringing wires of every description upon poles or fixtures of any kind, and in tightening all gauges of wire to any advisable degree of tension.

It is available for use in making repairs to "live" wires without the necessity of employing the usual cut-outs, thus preserving the lineman from the danger of the cut-out falling off—the tool itself being entirely of metallic construction completes the circuit.

On electrical test it has been shown that the combined vise and winch shows no resistance. An example of the usefulness and worth of the implement is summed up in the following: One man can pull up two miles of wire at one time and with greater ease, more quickly and more effectively than the usual gang of four men can pull up two ordinary sections with the strap and vise, or block and fall, in use at present. As an indi-



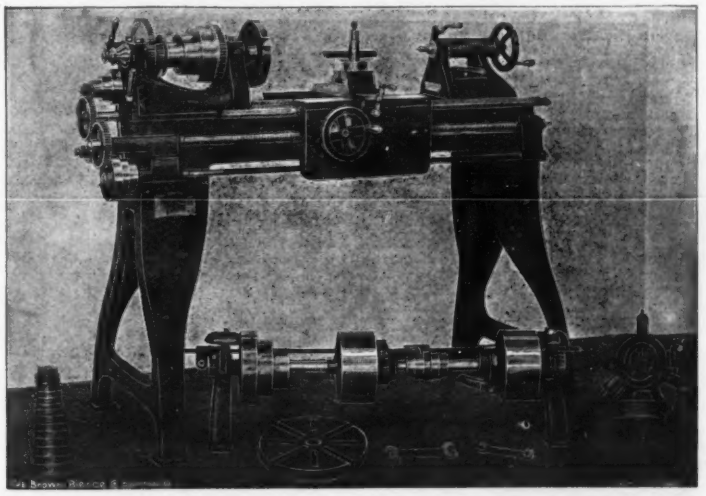
COMBINED VISE AND WINCH.

cation of its power it is only necessary to state that it can pull apart a No. 8 iron wire in an ordinary section. Its merit lies in saving money, labor, time and life. The weight of the tool is about six pounds.

Machine Tools.

The A. P. Wagner Tool Works, Sidney, O., have a large and complete plant for the manufacture of lathes, grinders, etc. It is lighted and heated throughout by electricity generated on the premises, and its equipment is new and most modern.

The company builds lathes of 8, 10, 12, 14 and 18 inches, which are claimed to be second to none in the market, and in their manufacture a rigid system of inspection is pursued, and each machine is practically tested before shipment.



SCREW AND ROD-FEED ENGINE LATHE.

The accompanying illustration shows a screw and rod feed engine lathe of the Wagner Company's make. It is equipped with a 3-speed cone, plain rest and friction countershaft. This machine is both strong and durable. The company is also building a full line of turrets, plain and automatic.

Flexible Pole Bracket.

The Craighead flexible pole bracket shown herewith is claimed by the Central Electric Company, of Chicago, to be the only non-infringing pole bracket on the market. These brackets are furnished for wooden or iron poles, either double or single track, and for side or centre pole construction. They are made, when so specified, so as to insulate the bracket from the pole, thus giving a secondary insulation and overcoming the ability of grounds or leakages through contact with the bracket.

Acetylene Motors.

Our French contemporary, *L'Industrie Electrique*, quotes a statement from an Italian journal to the effect that a Mr. Pedreti has constructed a motor operated by acetylene gas for running a bicycle; it can run 15 hours, weighs about 20 pounds, and can develop a useful power of 62-kilogram metres per second, measured with a brake; the cost of the carbide consumed is not more than 1 cent per hour. Our French contemporary comments humorously on it and shows from the results that it would be more advantageous for electric central stations to manufacture the carbide for such motors, instead of using the current directly for motors; also that the carbide would then serve to produce economically the electric energy used for its own manufacture.

NEWS OF THE WEEK

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, June 27, 1896.

DIVIDEND.—The Edison Electric Illuminating Company, of New York, has declared a quarterly dividend of 1½ per cent. payable Aug. 1.

GENERAL ELECTRIC.—A net loss of 2⅛ points is the record for the week's trading in General Electric. The highest price brought was 32 and the lowest 29¼, closing at 30⅛. The number of shares dealt in was 8600, which is some what below the average.

TELEGRAPHS,—Western Union in common with the General Electrical list dropped in price, the net loss being 1¼. The dealings were not up to the average.

TELEPHONES.—The telephone list was an exception to the general rule among electrical stocks and held its own ground. Bell shares stand about where they were last week and the other telephone stocks remain about quiet.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked.
Chicago Edison Company	100	118¼	..
Edison Electric Ill., New York	100	95	97
" " " Brooklyn	100	99	102
" " " Boston	100	135	140
" " " Philadelphia	100	137	..
Edison Ore Milling	100	13	15
Electric Storage Co., Philadelphia	100	28	28½
Electric Storage, pref	100	28½	30
General Electric	100	30	30¼
General Electric, pref	100	71	73
Westinghouse Consolidated, com	50	..	31
" " pref	50	50	53

BONDS.

Edison Electric Ill., New York	105	107	..
Edison Electric Light of Europe	100	75	85
General Electric Co., deb. 5s	100	92½	..

TELEGRAPH AND TELEPHONE.

American Bell Telephone	100	206	208
American District Telegraph	100	38	40
American Telegraph & Cable	100	91½	94½
Central & South American Telegraph	100	124	127
Commercial Cables	100	150	..
Erie Telephone	100	59	59½
New England Telephone	100	92	..
Postal Telegraph-Cable	100	85½	87
Western Union Telegraph	100	83¼	83½

ELECTRIC TRACTION STOCKS.

Baltimore Traction	25	18¼	18½
Brooklyn Rapid Transit		22	23
Brooklyn Traction	100	..	14
" " pref.	100	46	48
Buffalo St. Ry	100	68	70
Cleveland Electric Ry	100	..	..
Columbus St. Ry	100	45	47
Hestonville	100	53½	54½
" pref.		..	62½
New Orleans Traction	100	12	14
" " pref.	100	55	60
North Shore Traction	100	24	26
" " pref.	100	75	78
Rochester St. Ry	..	..	25
Steinway Ry	..	45	50
Union Railway (Huckleberry)		98	105
Union Traction, rcts $10 pd	..	14⅛	14¾
West End, Boston	100	69	70
" " pref.	100	87	..
Worcester Traction	100	15	17
" " pref.	100	88	90

BONDS.

Brooklyn Rapid Transit 5s, 1945	100	78½	80
Buffalo St. Ry. 1st con. 5s	100	105½	*107½
Cleveland Elec. Ry. 1st mtge 5s	100	100	103
*Columbus St. Ry. 1st 5s	100	93	97
Rochester St. Ry. 1st 5s	100	99½	102
Union Railway (Huckleberry) 1st mtge 5s		102½	105
*Westchester Electric 1st mtge 5s	100	100	102

* With accrued interest.

TRACTIONS.—The demand for electric railway securities showed a slightly better tone during the past week, but the bulk of the trading increased very little. There seems to be a disposition to withdraw stocks from the market temporarily as the bid quotations approach the former asked prices. Brooklyn Rapid Transit shares show a net loss of 1¼ on the week's transactions.

PITTSBURG, PA.—It is reported that the Pleasant Valley Traction Company has been sold to Brown Bros. & Co., bankers, of New York, Baltimore, Philadelphia and London, for about $1,500,000. The formal transfer of the property will be made about July 1. It is stated that the same syndicate is endeavoring to secure control of the Manchester and Birmingham Traction Companies.

Special Correspondence.

NEW YORK NOTES.

Office of THE ELECTRICAL WORLD,
253 Broadway, NEW YORK, June 29, 1896.

NEW ELECTRICAL FACTORY BUILDING.—The Western Electric Company has prepared plans for a new 10-story brick store and terra-cotta factory building which it will erect at a cost of $1,000,000, on a plot 285.9 x 142.10, at the southeast corner of Bethune and West Streets. The building will be rectangular in shape, with a court in the centre, opening on West Street.

LOST MONEY QUICKLY FOUND.—The New York Carbon Works came very near being the loser of a large sum of money. On Monday last a clerk set out to deposit in the bank $4,346.71, and on the way there dropped the envelope containing the bills and checks. It was picked up by a boy and handed to a policeman, who took it to the Church Street station house. It was restored to its owner later.

THE PIONEER ENCLOSED ARC LAMP.—The Electric Arc Light Company, New York, is meeting with considerable success with its Pioneer enclosed arc lamp. The great advantage of the long life of carbons in this lamp is being recognized. It is said that it saves 90 per cent. of the total number of trimmers and 90 per cent. of the cost of carbons per annum. The fact that it gives a shadowless light is also a strong point in its favor. Lamps of this type are very neatly displayed in the show-room of the company at 687-689 Broadway.

NEW ENGLAND NOTES.

Branch Office of THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, MASS., June 27, 1896.

A FINE NUMBER.—The Worcester *Daily Spy* celebrates its 126th anniversary by issuing an industrial edition, dated June 20. Among the Worcester interests which are described are the Worcester Consolidated Street Railway Company and the Worcester Electric Light Company.

PATRIOTIC.—The American Electrical Works, Phillipsdale, Providence, R. I., never lets a Fourth of July pass by without celebrating it in some original manner. This year it is helping its friends to celebrate the day by sending out a Winchester rifle (wooden). This gun is a great improvement over all others because one may look down the inside of the barrel and live.

THE ANCHOR ELECTRIC COMPANY, Boston, is unusually busy with orders, in fact dull business is as yet something unknown to it. This, however, occasions no surprise with those who know its energetic managers, some one of whom, outside of its numerous salesmen, are most always visiting its agencies and patrons, thereby keeping in close touch with them. Treasurer Reynolds has been in the West for the past 10 days; Vice-President Marshall is circulating somewhere and President Hawks is at home during their absence working like a beaver.

MESSRS. S. C. NIGHTINGALE & CHILDS, Boston, Mass., the New England agents for Keasbey & Mattison's magnesia covering and high-grade steam specialties, have removed from 134 Pearl Street to 451-461 Atlantic Avenue, their business having grown to such proportions as to render necessary quarters giving greater room. Their present location consists of a basement of about 4500 feet for storing and handling supplies, and offices and salesroom above of about 2000 feet. There is also an entrance at 171 Oliver Street. Messrs. Nightingale & Childs have abundant reasons for feeling proud of their business record, and their integrity and enterprise are unquestioned. Keasbey & Mattison magnesia covering is one of their principal specialties, and through their energetic efforts it is used in at least three fourths of the steam plants of New England.

WESTERN NOTES.

Branch Office of THE ELECTRICAL WORLD,
936 Monadnock Building,
CHICAGO, Ill., June 27, 1896.

RECEIVER APPOINTED.—The Falls Rivet & Machine Company, Cuyahoga Falls, O., has gone into the hands of a receiver, Mr. J. A. Long having been appointed as such.

RESIGNED.—Mr. Cyrus Robinson, of the Mining Department of the Jeffrey Manufacturing Company, Columbus, O., has resigned his position with that company. His resignation took effect July 1.

UNIQUE CATALOGUE.—The A. P. Wagner Tool Works, Sidney, O., has just issued a new catalogue of new lathes, etc. It is printed in four languages—English, French, German and Spanish—each containing a telegraph code.

THE METROPOLITAN ELECTRIC COMPANY, Chicago, has taken the Northwestern agency of the Missouri Telephone Manufacturing Company, of St. Louis, Mo., and is carrying a full line of the latter company's telephones, switchboard apparatus and patent gravity hooks. All telephones are guaranteed.

EXTENDING ITS BUSINESS.—The Missouri Telephone Manufacturing Company, St. Louis, Mo., has just inaugurated a new departure in its business. It will henceforth be classed as a manufacturer in the telephone business and not as an assembler. The company is increasing its facilities and preparing to wind coils, manufacture receivers and transmitters of various styles and switches.

JAMES C. WORMLEY & CO., Marquette Building, Chicago, report to be meeting with great success with their apparatus for testing the consumption of current required by incandescent lamps. This apparatus is said to be not only very accurate, but simpie and rapid in operation, and that a barrel of lamps can be measured in one hour. Messrs. Wormley & Co. report to be doing a large business also in high-grade incandescent lamps.

THE SUNBEAM INCANDESCENT LAMP COMPANY, Chicago, has recently purchased a new factory located at Desplaines, Ill., a few miles west of Chicago. The factory is a substantially built brick structure, and will give about double the floor space of its present factory. It will be fitted up with all of the very latest devices used in the manufacture of lamps which will give the Sunbeam Company facilities that are second to none, and a largely increased capacity.

MESSRS. WHITESIDE & FOSTER, Western representatives of the Triumph Electric Company, Cincinnati, also of the Fisher Foundry & Machine Company, Pittsburg, have made the following sales: One 25-hp reversible motor and 4-kw generator to the Diamond Match Company plant, Oshkosh, Wis.; one 100-hp Fisher engine to the Wyandott Mining, Milling & Smelting Company, Loomis, Wash.; one 35 kw Triumph generator to the Pabst Brewing Company, for its Summer resort at White Fish Bay, Wis.

THE ELECTRIC APPLIANCE COMPANY has taken the general Western agency for the Boudreaux dynamo brush and is carrying a complete stock in Chicago. These brushes are used almost exclusively by the United States Government, and by the largest manufacturers of electrical machinery in the United States, and are great commutator savers. The Electric Appliance Company has also taken the general Western agency for the Armorite iron-armored interior conduit, which is creating favorable comment on account of its many unique and desirable features. The Electric Appliance Company considers Armorite a "winner."

ENGLISH NOTES.

(From Our Own Correspondent.)

LONDON, June 17, 1896.

CENTRAL LONDON RAILWAY.—Your readers might possibly like to know the exact position of affairs with regard to this company, which is to run its line across London from west to east. All the tenders for the tunnel and station work have been let, and the work is expected to commence within a few days, and it is anticipated that the line will be ready for working at the date agreed upon.

ELECTRIC TRACTION ON THE INNER CIRCLE.—A paragraph went round the daily papers last week that there had been some electric traction trials on the inner circle after hours. As a matter of fact, experiments were merely made to ascertain the starting power and speed of an ordinary steam locomotive attached to a fully loaded Metropolitan train. The data thus obtained would certainly be made use of in connection with an electric traction scheme, but I am authoritatively informed that at present nothing definite has been placed before the two companies concerned.

A WILLANS PATENT.—Notice has been given that Messrs. Willans & Robinson propose to petition for a prolongation of their patent, No. 4991, of Oct. 14, 1882. This patent relates principally to the use of the air cushion, which may be said to constitute one of the chief parts of the Willans engine. The idea undoubtedly possesses that unusual merit which it is necessary that a patent should have in this country before the authorities will so much as consider its prolongation, but in view of the great prosperity of the Willans & Robinson Co., it will be interesting to see what arguments are brought forward to prove that the financial return upon this patent has been inadequate.

LORD KELVIN'S JUBILEE.—The focus of scientific interest is undoubtedly at the present time at Glasgow, where a large number of British and foreign scientists have assembled to do honor to Lord Kelvin on the occasion of the completion of his 50th year in the Chair of Natural Philosophy at the Glasgow University. The proceedings opened on Monday evening with a *conversazione* in the college buildings, where a number of distinguished visitors were received by Lord and Lady Kelvin, who received the congratulations of the guests. One of the special features of the *conversazione* was an exhibition of the principal inventions of Lord Kelvin. During the evening an immense number of telegrams were received from all parts of the world, the recording instruments being in operation in the upper hall of the library. On the following day, in the morning, Lord Kelvin received a large number of addresses of congratulation from representatives of the principal universities, learned societies, etc., all over the world. Later in the day the University of Glasgow conferred the honorary degree of Doctor of Laws upon Lord Kelvin, and subsequently upon a large number of scientists from abroad, these latter including Profs. Abbe, of Washington; Mascart and Moissan, of Paris; Newcomb, of Baltimore, and Quincke, of Heidelburg. In the evening Lord Kelvin was entertained by the corporation and University of Glasgow at a banquet given in the St. Andrew's Hall, the largest hall in the city.

THE FIRST ANNUAL CONVENTION OF THE MUNICIPAL ELECTRICAL ASSOCIATION.—This was held last week and proved a distinct success. As I previously stated, there was a plethora of papers of great practical value. The organization of the meeting reflects great credit upon those responsible for it, and the attendance was excellent, both from the point of quantity and quality. The permanent secretary of the Board of Trade and their electrical adviser not only attended, but took part in the discussions, as did the representatives of several electric lighting committees. In addition to the reading of the papers, visits were paid to the more interesting electrical sights of the metropolis. Perhaps the two most important discussions were those appertaining to the still burning 200-volt lamp question, and to the carrying out of consumer's wiring by electrical undertakers. There was just as much divergence of opinion as to the value and expediency of these high-voltage lamps at the Municipal Electrical Association, as there was a few months ago at the Institution of Electrical Engineers. It is encouraging to note that municipal electrical engineers, who are mostly young men, are determined not to be rushed into a new thing until they have thoroughly satisfied themselves as to its advantages. This is especially encouraging in view of the tremendous pressure that is being put upon these engineers to take part in the new movement. It is evident that the majority of our engineers mean to wait a little longer, to make sure that the results hitherto obtained at St. Pancras, Bradford and elsewhere will be maintained. A paper was also read before the Municipal Electrical Association by the engineer of the Manchester Corporation, in which he clearly showed his preference for the drawing up of a stringent and uniform set of wiring rules and their rigid enforcement. I am glad to say that there was a general consensus of opinion that all municipalities should undertake house wiring themselves, and I am sorry to say that a large majority of those present were strongly in favor of making wiring rules as stringent as possible and enforcing them as severely as possible. This sort of thing may be extremely good on paper, but one or two speakers pointed out that no good could come of irritating and alarming consumers by flourishing severe rules in front of them and worrying their lives out about the matter, and that consumers will only draw the conclusion that electric light is a terribly dangerous thing, and not worth the bother it entails.

General News.

NEW INCORPORATIONS.

THE LOGAN ELECTRIC LIGHT COMPANY, Logan, Ia., has been incorporated by L. P. Bradley and C. F. Luce, with a capital stock of $12,000.

THE OXFORD ELECTRIC LIGHT COMPANY, Oxford, Me., has been incorporated with a capital stock of $5000. The officers of the company are W. A. Greenlaw, president, and H. C. Rowell, treasurer.

THE KITTANNING TELEPHONE COMPANY has been incorporated at Kittanning, Pa., with a capital stock of $4000. The officers are J. G. Ayers, president; K. B. Schotte, secretary; C. J. Jessop, R. P. Marshall and Abe Greenbaum.

THE SHADOWLESS ARC LIGHT COMPANY, Pittsburg, Pa., has been incorporated in West Virginia, by J. C. Wainwright, D. N. Seeley, W. A. Schmidt, Pittsburg, and Conrad Webb, Bennett, Pa. Capital stock, minimum, $500; maximum, $100,000.

THE UNION ELECTRIC TELEPHONE COMPANY, of Waucoma, Ia., will build, equip, operate and own telephone lines. Capital stock, $100,000. Incorporators are J. F. Cass, L. S. Cass, Chas. Webster, Ace Webster, Thomas A. Way and T. A. Potter.

THE MARIETTA ELECTRIC COMPANY, Marietta, O., has been incorporated in West Virginia for the purpose of building and operating an electric railway. The incorporators are Nelson Moore, Andrew L. Gracey, J. S. H. Tomer and John Kaiser, Marietta, O. Capital stock, minimum, $30,000, maximum, $250,000.

THE FLAT TOP CENTRAL ELECTRIC SUPPLY & TRACTION COMPANY, Bramwell, W. Va., has been incorporated with a capital stock of $500,000, for the purpose of building an electric road between Roseville and Kimball. The incorporators are L. E. Tierney, of Powhatan, and H. Bert Wright, of Kyle.

THE GULF COAST CONSTRUCTION COMPANY, Clarksburg, West Va., has been incorporated to construct, operate and maintain cold storage, electric light, gas and water plants. Those interested are T. C. Arnold, Hemphill, Tex.; Fred Balcom, Jacksonville, Fla., and S. B. Cooper, Woodville, Tex. Capital stock, minimum, $500, maximum, $5,000,000.

THE CATARACT POWER & CONDUIT COMPANY, Buffalo, N. Y., has been formed by Daniel O'Day, Edward D. Adams, Francis Lynde Stetson, Edward A. Wickes, William B. Rankine, Darius O. Mills and John Jacob Astor, all of New York City, and George Urban, Jr., and Charles R. Huntley, of Buffalo. The capital stock of the company is $2,000,000.

THE COMPRESSED AIR POWER COMPANY, of New York City, has been incorporated with a capital stock of $1,000,000, to manufacture power plants, machinery and apparatus and supply power to railway and manufacturing companies. The directors are: John McKinlay Wight, Alfred C. Jopling, Adolph C. Wappler, Frederick S. Woodruff, Theo. L. Cuyler, Jr., Henry F. Hawkins and Isaac Smith, of New York; George E. Howard, of South Orange, and Michael Sandford, of Hackensack.

TELEGRAPH AND TELEPHONE.

BERGEN, N. Y.—A project is on foot to connect Bergen with adjoining towns by telephone.

STANTON, MICH.—A telephone line between Stanton and Entrican will probably be built soon.

MAPLETON, MINN.—The telephone line between this place and Minnesota Lake has been completed.

MARION, O.—The Central Telephone Company will build a new line between Columbus and Toledo.

COLORADO SPRINGS, COL.—The Colorado Telephone Company has applied for a franchise in Palmer Lake.

WASHINGTON, PA.—The Waynesburg Telephone Company will shortly erect a line between Washington and that place.

GREENVILLE, TEX.—The telephone system of this place has been sold to John D. Williams and R. C. Hawley, of Sulphur Springs.

SWEETWATER, TENN.—A telephone line is to be built by the East Tennesee Telephone Company from this place to Madisonville.

FORT DODGE, IA.—The Fort Dodge Telephone Company; capital, $10,000. Incorporators: E. H. Martin, C. F. Duncombe and C. W. King.

HARTFORD, CONN.—The work of excavating on Main Street was begun for the purpose of providing telephone and electric light conduits.

MARINETTE, WIS.—The work on the long-distance telephone line which will connect Marinette with all the leading upper peninsula cities has been commenced.

THE ERIE TELEGRAPH & TELEPHONE COMPANY made a net gain of 158 subscribers in May. Total gain for first five months, 1163. Total number connected, 19,754.

EAST LIVERPOOL, O.—Work on the new telephone line between this city and Burgettstown will soon be commenced, and the wires will be strung to Salineville in a short time.

SHARON, PA.—The Bell Telephone Company recently succeeded in convicting a wealthy junk dealer of this place, who was concerned in the theft of 2500 pounds of copper wire belonging to the company.

Electric Light and Power.

NORWICH, N. Y.—The Ontario & Western Railroad Company proposes to erect an electric light plant in this place to light its buildings and yard.

CHESTER, PA.—The Beacon Electric Light Company has purchased a lot of ground along the Chester Creek, and will commence the erection of a plant thereon at once.

NORTHVILLE, N. Y.—The Northville Electric Light & Power Company has decided to double the present capacity of its plant, to meet the demand for light and power.

ST. JOSEPH, MICH.—The St. Joseph & Benton Harbor Electric Railway & Light Company has secured a five-year contract from this city for 40 arc lights at $96 each per year.

STOCKTON TOWN, N. J.—The Town Council has voted unanimously to establish an electric light plant, and the solicitor has been instructed to draft an ordinance for the same.

MILWAUKEE, WIS.—The County Board Committee on Insane will recommend an appropriation of $40,000 for a new lighting and heating apparatus for the hospital for the insane.

DEXTER, MO.—The city of Dexter authorized the City Council to issue $10,000 city bonds for the purpose of erecting an electric light plant and making other public improvements.

MASCOUTAH, ILL.—The plant of the Mascoutah Electric Light Company which was destroyed by the recent tornado, has been entirely rebuilt, and the city was lighted up for the first time since the disaster on June 10.

ORANGE, N. J.—The erection of the People's Electric Light & Power Company's new plant in this city will soon be commenced. The company has purchased considerable more property along the Watchung Railway.

WESTCHESTER, PA.—The contract for the erection of the $10,000 electric light plant for the West Chester State Normal School has been let. The plant will be ready for operation by Aug. 20, and will have a capacity of 600 incandescents and 25 arc lights.

WORCESTER, MASS.—A storage battery plant is likely to be installed in the new State Mutual Insurance Building. The object is to use the battery for the day lighting. One hundred cells will be installed, and these will have a sufficient output for 350 lights for 12 hours.

NEW WILMINGTON, PA.—Prof. W. J. Shields, electrical engineer, has installed an electric light plant and storage battery. The power is furnished by a gasoline engine, and by the use of the storage battery it is not necessary to run the engine on Sunday. Gen. W. A. Clark, the owner of the plant, is now considering the project of enlarging it, and operating a three-mile line of railway by electricity.

NEW ORLEANS, LA.—The Edison Electric Light Company has purchased the building adjoining its plant on Baronne Street, now occupied by the Southern Electric Supply Company, and will erect on the site a six-story building. When this is completed the premises now occupied will be torn down and a like building erected. These improvements will give the Edison Company one of the most complete and finest electric stations in the United States.

The Electric Railway.

CHICAGO, ILL.—It is stated that compressed air motors are to be tested on some of the Chicago street car lines. The test is to be made by the General Electric Company and will continue for three months.

SCRANTON, PA.—Scranton's Select Council has decided to recommend the granting of a franchise to the Citizen's Electric Railway Company, which was recently chartered, to build a competing line in Scranton.

POTTSVILLE, PA.—At a meeting of the Schuylkill Electric Railway Company, at Pottsville, it was resolved to complete the extension to Schuylkill Haven and through the Heckscherville Valley before Fall.

CHATTANOOGA, TENN.—It is reported that the Chattanooga Electric Street Railway Company has decided to expend about $100,000 in improvements and extensions of its line. C. A. Lyerly is president.

ANACOSTIA, D. C.—Engineers are engaged in surveying the route from the Capital Railway Company's line, from Congress Heights to the city proper, and it is expected that the work of construction will be begun very soon.

NEW BRIGHTON, S. I., N. Y.—The Staten Island Electric Railway Company has filed a certificate of extension of its road in New Brighton and the town of Northfield, Richmond County, with the Secretary of State at Albany.

NEW CASTLE, PA.—The syndicate of Pittsburg, Pa., capitalists, which recently secured control of the street railway system of New Castle, is making extensive improvements. New lines are to be laid and the equipment will be much improved.

SISTERSVILLE, WEST VA.—Engineers have started to survey the route for an electric freight and passenger road from this city to a point on the Baltimore & Ohio Railroad, near Clarksburg, this State. It will probably be about 30 miles long.

PHILADELPHIA, PA.—It is stated that a new trolley line is to be built between Bristol and Philadelphia. The length of the road will be nine miles, and it will be a single track line with turn-outs. The electric equipment will be that of the General Electric Company.

ANDERSON, IND.—A scheme is on foot to consolidate all of the electric railways of Indiana, taking in all the Indiana gas belt towns. The object of the plan is to afford a complete system of electric railways over the State for passenger, express and freight service.

ST. JOSEPH, MICH.—The St. Joseph & Benton Harbor Street Railway Company has just been granted a franchise for an electric railway through the city of St. Joseph, beginning at the terminus of the present tracks and extending two miles south, franchise to run for 30 years.

JOLIET, ILL.—Negotiations are now in progress between William McKinley of Champaign, and Senator Macomber of Augusta, for the purchase of the Joliet Electric Street Railway from J. A. Henry. When the transfer is made $50,000 will be spent in extending the lines.

BALTIMORE, MD.—Mayor Hooper has signed the ordinance authorizing the Traction Company to lay tracks on Presstman Street, from Fremont Avenue to Monroe to the Windsor Mill Road, to Slingluff Avenue to the Old Liberty Road. The work of construction is to be completed within 12 months.

CHICAGO, ILL.—The General Electric Company has secured the contract to supply the entire electrical equipment of the rolling stock for the Northwestern Electric Elevated Railway Company of this city. The apparatus will be similar to that furnished to the West Side and Lake Street elevated railways.

Personal Notes.

MR. S. DANA GREENE, of the General Electric Company, Schenectady, N. Y., was married in Batavia, N. Y., on June 25, to Miss Cornelia Chandler, daughter of the late Rear Admiral Chandler, of the United States Navy. Many persons from New York and other cities were present.

LIEUT. MANNING K. EYRE has been promoted to the managership of the Edison Lamp Company, Harrison, N. J. Lieut. Eyre has been advanced to this important office by successive steps during the past three years from a minor position in the New York lamp office. He had full charge of the factory as assistant manager for some months previous to his last promotion.

Trade and Industrial Notes.

THE REEVES CLUTCH.—Patterson, Gottfried & Hunter, Ltd., New York, in a neat little pamphlet, illustrate and describe the Reeves wood split pulley clutch.

THE CLONBROCK STEAM BOILER WORKS, Brooklyn, N. Y., are rushed with orders just now for their well-known boiler. They are, however, keeping well up in their work, and not getting behind any.

HANDY FOR THE DESK.—The Tucker Electrical Construction Company, 14-20 Whitehall Street, New York, is presenting to the trade a 15-inch wooden brass edge desk ruler. Such a ruler is always handy about the desk.

THE BROWN & SHARPE MANUFACTURING COMPANY, Providence, R. I., has just issued an artistically gotten-up pamphlet, entitled "Views Within Our Works." It an excellent example of the printers' and engravers' art, the illustrations being well executed.

MICA.—The Palermo Mica Company, New York, has just issued a little catalogue and price list of its mica specialties. This company makes a specialty of India sheet mica and amber sheet mica for electrical purposes, and cuts mica to any pattern for machine insulation.

THE BERLIN IRON BRIDGE COMPANY, East Berlin, Conn., has secured the contract for a steel rolling-mill building, 103 feet wide and 112 feet long, from the Pennsylvania Bolt & Nut Company, Lebanon, Pa. The building will have a steel frame, and the roof and sides will be of corrugated iron.

GERMAN ELECTRICAL APPARATUS.—Brown, Boveri & Co., Frankfort-on-the-Main, Germany, have issued an artistically designed catalogue of their electric light and electric power generating apparatus of all types, and of their single-phase motors. The catalogue is very handsomely illustrated, showing various plants in which the company's apparatus has been installed.

ARTHUR J. FARNSWORTH has recently purchased the entire interest in the Capo-Farad Battery & Appliance Works, formerly owned and conducted by James J. Pearson, New York City. Mr. Farnsworth states that he is now prepared to make, in addition to the well-known Capo-Farad battery, all the appliances necessary for battery work. The special feature of the Capo-Farad battery is the extreme smallness of the cell, which renders it particularly suitable for portable work of all descriptions, such as medical coils, small illuminating work, blasting sets, bells, etc. Mr. Farnsworth also claims that one cell, two and three-quarter inches long by five-eighth inch in diameter, will ring an ordinary door-bell for one year.

THE GARLOCK PACKING COMPANY, Palmyra, N. Y., and Rome, Ga., has closed its office at Omaha, Neb., and opened a new office and salesroom at 1713 Wazee Street, Denver, Col. Mr. Chas. B. Witman, who is manager of the same, is well and favorably known by the trade. The principal salesrooms of the company are at New York, Chicago, Philadelphia, Denver, St. Louis, Pittsburg and Boston. The Garlock Packing Company are manufacturers of high-

grade packings for steam, water, gas, ammonia, etc. It manufactures water-proof hydraulic packing, also high pressure packing which is especially adapted for high pressure work on locomotives, stationary and marine engines, and is designed to insure long service. Samples, catalogue and prices will be mailed on application to the nearest office.

INCREASING THE SINEWS OF WAR.—Mr. A. K. Warren, of A. K. Warren & Co., 465 Greenwich Street, New York, has recently taken into partnership with him Mr. J. R. Steers. Mr. Warren started in the electrical repair business under the title of the "New York Electrical Repair Company," on a small scale about three years ago, and has been obliged, in order to take care of the work and insure prompt deliveries, to constantly increase his plant and facilities. A few months ago Mr. Warren began the business of electrical maintenance, as, from his repair business and shop facilities, he was in a position eminently fitted to take up that line. In addition to this, some of the largest electrical manufacturing companies having found it more economical to turn over to him the erection of all their large generators and machines in this vicinity than to send their own men from the factory, the business has grown beyond all proportions of what was anticipated. It was found that still more room, plant, and increased capital was required. Mr. Steers has put into the firm all the capital that is required for the necessary increase of plant, and for working capital. Two more floors, fully equipped with all the necessary machinery and appliances, have been added to their factory. Mr. Steers will have charge of all the office work and the finances of the company. The old title of "A. K. Warren & Co." will be continued.

TO INSTALL A TRAVELING CRANE.—The Culver Stone Company, Springfield, Ill., proposes to install at once an electric traveling crane, and it desires proposals for its construction. The following are the specifications: The electrical equipment may be one or three motors (General Electric Company's type of motor preferred); if one motor is used the necessary mechanical gearing must be used to hoist the load, traverse the trolley and move the bridge on the tramrails, of sufficient power to hoist a 25-ton load 20 feet high, at a maximum speed of seven feet per minute, the speed increasing as the load decreases. The traveling speed of the bridge shall be 125 feet per minute, and the traverse-speed of the trolley shall be not less than 50 feet per minute under maximum load, all controlled by suitable mechanical or electrical brakes sufficient to stop under maximum load, and particularly to prevent the racing of the load, which shall be controlled automatically. The bridge shall have a span of 50 feet centre to centre of tracks, and may be of two single-plate girders or two box girders of ample size and capacity to sustain the load in any position with a factor of safety of five. The end carriages may be of suitable pattern with chilled supporting wheels 18 inches in diameter, double flange, steel, turned four-inch axles, two of these wheels to be propelled by a longitudinal shaft running the length of bridge; connection for reducing the speed of the motor, the operators' cage to be suspended from one side of the bridge and constructed of angles and tees, drilled and flanged to receive woodwork, which the Culver Company will furnish, to enclose motors from the weather. In case three motors are used the trolley is to have a similar suitable framework for completely enclosing it, the entire bridge to have brackets and angle iron supports for a slatwork or footway with suitable supports and hand-rail its entire length above bridge, also to have suitable rheostats and controllers to enable the speed to accelerate from zero to the maximum, necessary switches and wiring for the bridge, etc.

Business Notices.

The illustrations in this issue were made by the Photo-Engraving Company, 67-71 Park Place, New York.

BATTERY CUT-OUT CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 15 South Warren Street, Syracuse, N. Y.

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED JUNE 16, 1896.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

562,064. SYSTEM OF TELEPHONIC EXCHANGE; S. Berditschewsky, London, England. App. filed March 23, 1896. In an automatic telephone-exchange system, wherein the members of each subscriber's line, the switches in which they terminate, and the contacts on which said switches normally rest, and over which they are traversed, are connected in groups differently formed for the positive and negative members, the combination with each switch-carrier, of a screw-spindle mounted to rotate, and of electrically operated mechanism adapted to impart step by step rotary motion to the screw spindle, the switch-carrier being formed as a nut adapted to be traversed upon the screw spindle when it is revolved by the electromagnetic propelment mechanism for traversing said switch over the corresponding row of contacts.

562,118. EMERGENCY ELECTRIC BRAKE; B. F. Card, Brooklyn, N. Y. App. filed Feb. 6, 1896. An emergency electric brake for street cars, consisting of the combination of an electromagnet, brake shoes for the wheels, levers for operating the brake shoes, an armature for the magnet, and ball bearings between the levers and bars, which are elastically connected to the armature.

562,208. SAFETY LAMP; W. Waegel, Philadelphia, Pa. App. filed Oct. 22, 1895. In a safety incandescent lamp, a casing by which said lamp is surrounded and hermetically sealed, a valve through which said casing may be filled with an extinguishing gas, a valve adapted to be closed upon its seat by means of said gas, a spring carried by said valve and adapted to close the electric circuit when said valve is closed and brake said circuit when said valve is open, and another spring adapted to open the said valve when the pressure in the casing is relieved.

UNITED STATES PATENTS ISSUED JUNE 23, 1896.

562,365. ALTERNATING-CURRENT MOTOR; E. Arnold, Zurich, Switzerland. App. filed Jan. 11, 1893. The method of operating motors for alternating and similar currents, by connecting the field coils and some of the armature coils with a source or sources of alternating or similar currents, and establishing induced currents in locally closed armature coils whereby two distinct movements may be produced varying with and regulated by, the speed of the motor. (See Illustration.)

562,366. ELECTRIC MOTOR AND DYNAMO; E. Arnold, Carlsruhe, Germany. App. filed April 5, 1895. The combination of an armature, coils commutator and brushes, with resistances in the commutator connections (whereby the short-circuited current generated when a brush is passing from one segment to another may be reduced) and with means for directly short-circuiting the several armature coils.

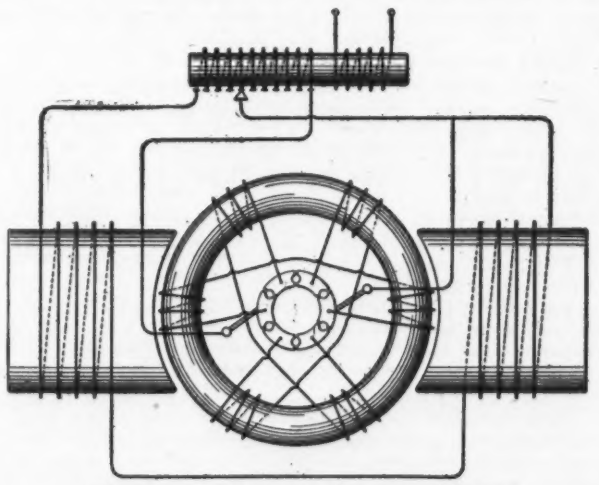
562,395. CIGAR LIGHTER; A. C. Gruhlke, Waterloo, and W. F. Kessler, Auburn, Ind. App. filed Dec. 6, 1895. In an electric cigar lighter, the combination with a tube, an anchor cap, a coiled spring and cap piece, the tube, conducting wires, an insulating plate secured to the tube with which one of said wires is connected, a pivoted contact piece and the coiled spring, of a pivoted oil receptacle electrically connected with the other wire, a boss having a beveled end, and a correspondingly beveled block formed with a gas chamber.

562,396. SECONDARY BATTERY; R. J. Gulcher, Charlottenburg, Germany. App. filed Feb. 29, 1896. An electrode comprising a fabric of lead and glass thread, a frame therefor, and a covering of spun glass.

562,429. ELECTRICAL ADVERTISING APPARATUS; C. E. Skinner, Pittsburg, Pa. App. filed Feb. 28, 1894. An insulating sign board, a conducting plate or plates on each side thereof, and letters or designs on one side of said board, in combination with a source of high-tension alternating current having its respective terminals connected with the plates on the two sides of said board.

562,431. ELECTRICAL RELEASING DEVICE; C. A. Stearns, Watertown, Mass. App. filed April 15, 1896. A releasing device adapted to be operated from a plurality of out-stations, consisting of an electromagnet, an armature therefor normally locked to a disengaging lever, a spring-impelled sliding bar, supported by the said lever, provided with a cam in contact with an abutting pin, and with means for connection with the releasing lever of a fire-alarm apparatus.

562,435. SYSTEM OF CURRENT SUPPLY FOR TELEPHONE CIRCUITS; J. S. Stone, Boston, Mass. App. filed April 23, 1896. In a central battery telephone system, the combination at a sub-station, of the primary and secondary helices of an induction coil, and a resistance-carrying transmitter, all connected in series in a main line telephone circuit containing the main transmitter battery, and a condenser in the branch of the said main circuit shunting the said primary helix and transmitter.



562,365.—ALTERNATING-CURRENT MOTOR.

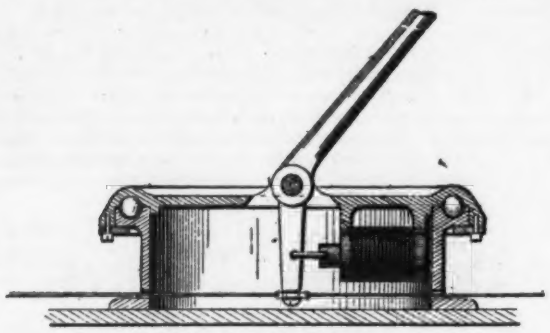
562,453. ELECTRIC RAILWAY; H. Brandenburg, Chicago, Ill. App. filed March 11, 1895. A rail formed in one piece for use in connection with electrical railways consisting of the web having a bottom supporting flange, and top supporting flange for the wheel, said top flange having a longitudinal recess or channel for the reception of the trolley conductor, and an independent depression or recess for the wheel flange.

562,483. TRAVELING CONTACT OR PLOW FOR UNDERGROUND ELECTRIC RAILWAYS; S. L. Phillips, Washington, D. C. App. filed Jan. 21, 1896. The combination of a plow, of an insulating cover comprising two sections, clamps for securing said sections to the plow, and fastenings for detachably engaging the ends of the sections.

562,484. TRAVELING CONTACT FOR UNDERGROUND ELECTRIC RAILWAYS; S. L. Phillips, Washington, D. C. App. filed Jan. 21, 1896. The

combination with a plow or traveling contact, of a cover of insulating material provided on opposite sides with openings, contact shoes secured in or projecting from said openings and springs interposed between the plow and contact shoes.

562,494. TROLLEY; H. A. Seymour, Washington, D. C. App. filed Feb. 20, 1896. The combination with a flexible trolley pole pivotally mounted on a car, and devices under the control of an operator for manually raising the trolley into contact with an overhead conductor of an electromagnet for forcing the trolley against the conductor with a pressure sufficient to maintain a good contact therewith when the car is running. (See Illustration.)



No. 562,494.—Trolley.

562,501. ELECTRIC CONTROLLER; E. A. Sperry, Cleveland, O. App. filed Feb. 20, 1895. In an electric controller, a set of contacts or electrodes, an electric machine connected therewith, power and brake circuits serving such machine, a main moving element of the controller for each circuit, in combination with means for dissimultaneous operation of the said moving elements.

562,502. ELECTRIC LOCOMOTIVE; I. E. Storey, Boulder, Col. App. filed June 29, 1892. The combination of a shaft or axle, an electric motor mounted upon the same and adapted to swing thereon, a gear wheel also mounted on said axle or shaft and with which the motor armature shaft is geared, and a stop limiting the movement of the swinging motor, the motor being free to swing from a point vertically below the shaft or axle to a point in a horizontal plane with the shaft or axle. (See Illustration.)

562,523. TROLLEY DEVICE; H. A. Gray, New Haven, Conn. App. filed Aug. 1, 1895. In a device for retaining a trolley wheel in contact with an overhead conductor, a head adapted to be secured to a trolley-pole, a trolley wheel suitably journaled upon said head, two arms mounted upon said head and projecting to a point above said wheel, anti-friction devices mounted upon said arms above said wheel and adapted for a rising and falling movement, and means for causing said devices to approach each other in the rising movement to close the opening between said arms.

562,527. RHEOSTAT OR ELECTRIC HEATER; W. S. Hadaway, Jr., New York, and W. E. Davis, Malden, Mass. App. filed July 18, 1895. In a rheostat or electric heater the combination of the casing, longitudinal bars on opposite sides thereof, and an insulated block carried by the casing, with insulators carried by said bars, a non-conducting core passing from one insulator to another, a helical resistance strung upon said core and attached thereto so as to be insulated from the casing, and conductors connecting the helix to the insulated block.

562,528. WIRE HOLDER; L. M. Hakansson, Mason City, Ia. App. filed April 23, 1896. A wire holder consisting of a head having two projections, a suitable distance apart on its upper face, oppositely inclined edges of said projections terminating near their upper ends in recesses combined with integral arms bent upon themselves and having recesses on their lower edges in alignment with the recesses on the projections of the head.

562,541. AUTOMATIC OPERATION OF ELECTRIC GENERATORS; F. E. Kinsman, Plainfield, N. J. App. filed June 23, 1893. The combination for train lighting of a locomotive boiler. a supplemental engine, a dynamo, and devices responsive to a predetermined pressure for connecting the dynamo-engine and boiler.

562,561. ESCAPEMENT MECHANISM; C. E. Allen, Washington, D. C. App. filed May 28, 1894. In an escapement mechanism for variable spacing, an escapement wheel or disc provided with hinged arms mounted thereon, in combination with means for engaging said arms and for releasing the same when desired.

562,564. BANK OF ELECTROMAGNETS; C. E. Allen, Salem, Mass. App. filed Oct. 28, 1895. A bank of electromagnets consisting of a number of staves or blades having magnetic cores therein arranged in sets of two or more, the said blades being so positioned with reference to each other that the magnetic cores therein will lie one behind the other in such manner as to convert the joint magnetic pull of corresponding magnets into a mechanical thrust.

562,591. APPARATUS FOR OPERATING TROLLEY ARMS; P. J. Dowling, Waterbury, Conn. App. filed July 23, 1895. In a trolley mechanism, the combination with a carrier of a trolley pole pivotally supported thereon, a slide movable in said carrier, means for normally elevating the pole, and a releaser in position to be actuated by the trolley pole above the pivotal point of said pole, on the movement of the pole beyond its working position, to thereby throw said pole away from the line system.

562,609. ELECTRIC ARC LAMP; D. Higham, Boston, Mass. App. filed March 31, 1896. An electric arc lamp provided with a frame and an upper carbon adapted to be fed down by suitable means, in combination with a closed hood fixed stationary with the lamp frame, said hood closely fitting and encircling the upper carbon immediately above the arc, and means for feeding up the lower carbon in proper relation to said hood.

562,633. OUTLET BOX AND FIXTURE SUPPORT; C. O. Mailloux, New York, N. Y. App. filed Feb. 20, 1895. The combination with an outlet box having a seat formed in the bottom thereof, of a removable bushing fitting to said seat, a bolt passing through said bushing for securing the box in place, and a gas elbow removably secured to the back of the box over the bushing seat.

562,639. AUTOMATIC RAILWAY SIGNAL; H. V. Miller, Bloomington, Ill. App. filed May 1, 1896. In a railway signal or alarm in combination with the rail supported by ties, a cross-bar attached to the ties, blocks attached to the cross-bar, and being free from the base of the rail, and a lever actuated by the depression of the rail, and held in a suitable frame or box resting upon the said blocks.

562,647. SYSTEM OF ELECTRICAL DISTRIBUTION; L. K. Oppenheimer, Cincinnati, O. App. filed Dec. 21, 1895. The method of distributing electrical energy to a plurality of translating-device circuits, which consists in supplying successive electrical impulses to said circuits, the ratio of the duration of said impulses being, approximately, to the duration of the intervening periods of cessation, as the ratio of one half of the E. M. F. required by the translating devices, when constantly supplied with current, is to the E. M. F. employed in excess of that required by said translating devices when constantly supplied with current.

562,658. ELECTRIC SWITCHBOARD AND CIRCUIT MAKER; A. L. Pratt, Kalamazoo, Mich. App. filed April 9, 1896. An adjustable switch lever provided with a series of notches, combined with a spring-actuated bolt having an annular groove or depression.

562,680. ELECTRIC METER; A. G. Waterhouse, Hartford, Conn. App. filed March 25, 1895. In an electric meter, an ammeter worked by the current to be measured, an intermittently-acting registering device worked by a force independent of the motion of the ammeter, a compensator worked by a force independent of the movement of the ammeter, and a separate electric circuit formed by the contact between said ammeter and compensator for controlling the movement of said registering device.

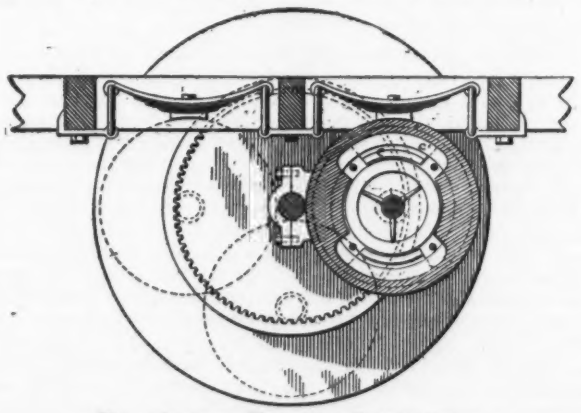
562,686. ALTERNATING-CURRENT MOTOR; M. J. Wightman, Lynn, Mass. App. filed July 26, 1888. An alternating-current motor provided with coils tending to establish opposite magnetic polarities at different points of a ring, in combination with a set of closed circuits in inductive relation to the magnetizing-coils, and means whereby the one or the other of said inductive circuits may be closed or opened for governing the direction of rotation of the armature.

562,731. ALARM; R. W. J. Kraus, New York, N. Y. App. filed Jan. 30, 1896. The combination of a cage, a barokinetic circuit-closer, and a guide for directing the falling of an unconscious body within the cage upon the circuit-closer.

562,745. CONTROLLING MECHANISM FOR ELECTRIC MOTORS; R. C. Smith, Yonkers, N. Y. App. filed Jan. 25, 1892. The combination with a shunt-wound motor, of a reversing-switch, a combined field and armature-circuit leading from said switch, resistances controlled by the switch and arranged to be included and excluded in the combined field and armature-circuit, and an auxiliary switch co-operating with the reversing-switch to change the direction of current in the armature-circuit.

562,765. MEDICAL ELECTRODE; W. P. Horton. Jr., Cleveland, O. App. filed Dec. 30, 1895. As new article of manufacture, a metallic electrode consisting of a plate having a flange on the front face, thereby forming a cavity for the reception of absorbent material, forwardly bent loops at its ends, and a binding post on its rear side.

562,775. ELECTRIC LIGHTER; H. E. Rider, Brooklyn, N. Y. App. filed May 2, 1895. A portable lighting torch comprising two parts held together but having a limited movement relatively to each other, one of said parts being adapted to be grasped by the hand of the user, said parts being in normal position when the torch rests upon a support, and being moved from such position when the torch is lifted from the support, and an electric igniting device operated by the relative movement of the parts to ignite the torch.



No. 562,502.—Electric Locomotive.

562,776. PROCESS OF UTILIZING MATERIAL OF WORN-OUT SECONDARY BATTERIES; W. L. Silvey, Dayton, O. App. filed Nov. 19, 1895. The process of utilizing the material of worn out battery plates in the production of new ones, which consists in first washing the plates in water to eliminate the sulphuric acid, then subjecting them to the action of heat in order to drive out the liquid held in suspension, then melting the plates and converting them into finely divided lead and oxides of lead, then adding a quantity of low oxide of lead, then forming the material into a paste and applying the paste to a grid, and finally hardening the plates.